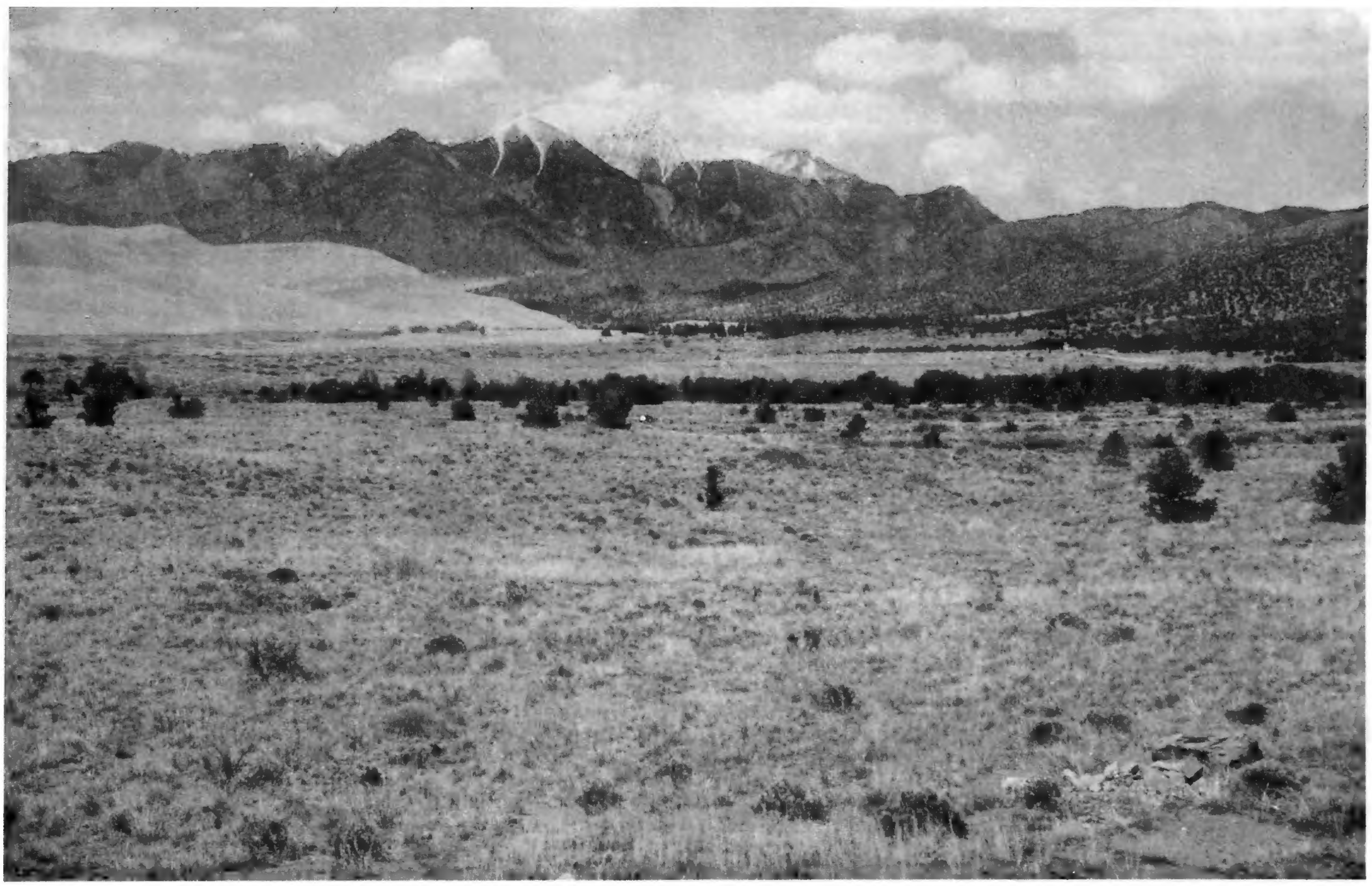
SOIL SURVEY OF

Alamosa Area, Colorado



United States Department of Agriculture
Soil Conservation Service
In cooperation with
Colorado Agricultural Experiment Station

Issued 1973

Major fieldwork for this soil survey was done in the period 1962-66. Soil names and descriptions were approved in 1968. Unless otherwise indicated, statements in the publication refer to conditions in the county in 1966. This survey was made cooperatively by the Soil Conservation Service and the Colorado Agricultural Experiment Station. It is part of the technical assistance furnished to the Mosca-Hooper Soil Conservation District.

Either enlarged or reduced copies of the soil map in this publication can be made by commercial photographers, or they can be purchased on individual order from the Cartographic Division, Soil Conservation Service, United States Department of Agriculture, Washington, D.C. 20250

HOW TO USE THIS SOIL SURVEY

THIS SOIL SURVEY contains information that can be applied in managing farms and ranches; in selecting sites for roads, ponds, buildings, and other structures; and in judging the suitability of tracts of land for farming, industry, and recreation.

Locating Soils

All the soils of Alamosa Area are shown on the detailed map at the back of this publication. This map consists of many sheets made from aerial photographs. Each sheet is numbered to correspond with a number on the Index to Map Sheets.

On each sheet of the detailed map, soil areas are outlined and are identified by symbols. All areas marked with the same symbol are the same kind of soil. The soil symbol is inside the area if there is enough room; otherwise, it is outside and a pointer shows where the symbol belongs.

Finding and Using Information

The "Guide to Mapping Units" can be used to find information. This guide lists all the soils of the area in alphabetic order by map symbol and gives the capability classification of each. It also shows the page where each soil is described and the page for the capability unit and range site in which the soil has been placed.

Individual colored maps showing the relative suitability or degree of limitation of soils for many specific purposes can be developed by using the soil map and the information in the text. Translucent material can be used as an overlay over the soil map and colored to show soils that have the same limitation or suitability. For example, soils that have a slight limitation for a given use can be colored green, those with a moderate limitation can be colored yellow, and those with a severe limitation can be colored red.

Farmers and those who work with farmers can learn about use and management of the soils in the soil descriptions and in the discussions of the management of irrigated soils, the capability units, and the range sites.

Game managers, sportsmen, and others can find information about soils and wildlife in the section "Use and Management of the Soils for Wildlife."

Ranchers and others can find, under "Use and Management of Rangeland," groupings of the soils according to their suitability for range, and also the names of many of the plants that grow on each range site.

Community planners and others can read about soil properties that affect the choice of sites for nonindustrial buildings and for recreation areas in the section "Use of the Soils for Recreation."

Engineers and builders can find, under "Engineering Uses of the Soils," tables that contain test data, estimates of soil properties, and information about soil features that affect engineering practices.

Scientists and others can read about how the soils formed and how they are classified in the section "Formation, Classification, and Morphology of the Soils."

Newcomers to the area may be especially interested in the section "General Soil Map," where broad patterns of soils are described. They may also be interested in the information given in the section "General Nature of the Area."

Cover: Foothill Sand range site on Mount Home-Saguache cobbly sandy loams, 4 to 12 percent slopes. This range site is in the Great Sand Dunes National Monument.

CONTENTS

	Page
HOW THIS SURVEY WAS MADE	2
GENERAL SOIL MAP	3
1. Gunbarrel-Mosca-San Luis association	3
2. McGinty-Gunbarrel association	4
3. Alamosa-Vastine-Alluvial land association	4
4. San Arcacio-Acacio-Zinzer association	5
5. Hooper-Corlett association	7
6. Costilla-Space City association	8
7. Uracca-Mount Home-Comodore association	8
8. Hapney-Hooper-Corlett association	8
9. Cotopaxi-Dune land association	10
DESCRIPTIONS OF THE SOILS	10
Acacio series	10
Alamosa series	12
Arena series	14
Comodore series	15
Corlett series	15
Costilla series	16
Cotopaxi series	17
Dune land	17
Graypoint series	17
Gunbarrel series	18
Hapney series	19
Homelake series	20
Hooper series	20
LaJara series	22
Laney series	22
LaSauses series	23
Littlebear series	24
Loamy alluvial land	25
Marsh	25
McGinty series	25
Medano series	26
Mosca series	27
Mount Home series	28
Nortonville series	28
Peat	29
Saguache series	29
San Arcacio series	30
Sandy alluvial land	31
San Luis series	31
Space City series	32
Uracca series	33
Vastine series	34
Villa Grove series	35
Wet alluvial land	36
Zinzer series	36
USE AND MANAGEMENT OF THE SOILS	37
Management of irrigated soils	37
Sources of irrigation water	37
Soil moisture as related to irrigation	38
Methods of applying water	38
Reclamation of saline and alkali soils	39
Weed control	40
Capability grouping	40
Management by capability units	41
Predicted yields of principal irrigated crops	51
Use and management of rangeland	51
Range sites and range condition	53
Descriptions of range sites	53
Use and management of the soils for wildlife	57
Use of the soils for recreation	57
Engineering uses of the soils	63
Engineering soil classification systems	63
Soil properties significant in engineering	64
Engineering interpretations	64
Engineering test data	98
FORMATION, CLASSIFICATION, AND MORPHOLOGY OF THE SOILS	98
Factors of soil formation	98
Parent material	98
Climate	99
Plant and animal life	99
Relief	100
Time	100
Classification of soils	100
Morphology of soils	102
Physical and chemical analyses	114
Field and laboratory methods	114
Interpretation of laboratory data	114
GENERAL NATURE OF THE AREA	115
History and development	115
Geology and physiography	116
Climate	117
Farming	119
LITERATURE CITED	119
GLOSSARY	120
GUIDE TO MAPPING UNITS—following	122

SOIL SURVEY OF ALAMOSA AREA, COLORADO

BY JAMES P. PANNELL, JAMES M. YENTER, STANLEY O. WOODYARD, AND

RICHARD E. MAYHUGH, SOIL CONSERVATION SERVICE

UNITED STATES DEPARTMENT OF AGRICULTURE, SOIL CONSERVATION SERVICE, IN COOPERATION

WITH THE COLORADO AGRICULTURAL EXPERIMENT STATION

THE ALAMOSA AREA is located in a broad, high mountain valley. This is the San Luis Valley, located in the south-central part of the State (fig. 1).

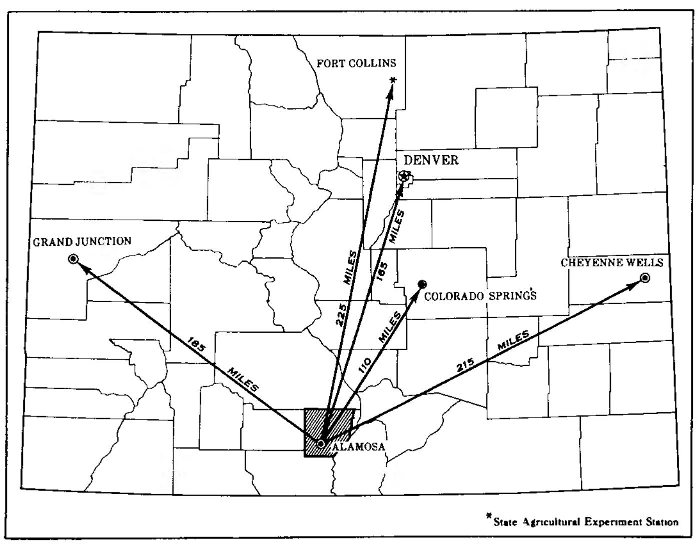


Figure 1.--Location of Alamosa Area in Colorado.

The survey area is approximately 27 miles square. It contains about 678 square miles, or 434,328 acres, and is within Alamosa County, Colorado. It is nearly level and has an elevation of approximately 7,500 feet, except for the extreme eastern part. The eastern edge of the survey area includes a small part of the Sangre de Cristo Mountain Range and rises to an elevation of about 11,000 feet.

A large part of the Area lies within a closed basin that has a high water table, is very strongly alkaline, and has no external drainage pattern. It has many lake basins, most of which are dry nearly all of the time. The Rio Grande River flows through the southwestern part of the survey area.

The climate is dry and cold. The average annual temperature at Alamosa is 41° F. The coldest recorded temperature is -50°, and the warmest is 90°. The average annual precipitation is 6.7 inches, and average annual snowfall is about 27 inches. The average length of the growing season is 96 days.

The Alamosa Area is mainly agricultural, and the principal enterprises are livestock raising and irrigated farming. The main irrigated crops are potatoes, barley, alfalfa, oats, and lettuce. Cattle and sheep are the livestock mostly raised.

HOW THIS SURVEY WAS MADE

Soil scientists made this survey to learn what kinds of soil are in the Alamosa Area, where they are located, and how they can be used. The soil scientists went into the Area knowing they likely would find many soils they had already seen and perhaps some they had not. They observed the steepness, length, and shape of slopes; the size and speed of streams; the kinds of native plants or crops; the kinds of rock; and many facts about the soils. They dug many holes to expose soil profiles. A profile is the sequence of natural layers, or horizons, in a soil; it extends from the surface down into the parent material that has not been changed much by leaching or by the action of plant roots.

The soil scientists made comparisons among the profiles they studied, and they compared these profiles with those in counties nearby and in places more distant. They classified and named the soils according to nationwide, uniform procedures. The soil series and the soil phase are the categories of soil classification most used in a local survey (18) 1/.

Soils that have profiles almost alike make up a soil series. Except for different texture in the surface layer, all the soils of one series have major horizons that are similar in thickness, arrangement, and other important characteristics. Each soil series is named for a town or other geographic feature near the place where a soil of that series was first observed and mapped. Acacio and Zinzer, for example, are the names of two soil series. All the soils in the United States that have the same series name are essentially alike in those characteristics that affect their behavior in the undisturbed landscape.

Soils of one series can differ in texture of the surface soil and in slope, stoniness, or some other characteristic that affects use of the soil by man. On the basis of such differences, a soil series is divided into phases. The name of a soil phase indicates a feature that affects management. For example, Acacio loam, 1 to 3 percent slopes, is one of several phases within the Acacio series.

After a guide for classifying and naming the soils had been worked out, the soil scientists drew the boundaries of the individual soils on aerial photographs. These photographs show woodlands, buildings, field borders, trees, and other details that help in drawing boundaries accurately. The soil map in the back of this publication was prepared from aerial photographs.

1/ Underscored numbers in parentheses refer to Literature Cited, p. 119.

The areas shown on a soil map are called mapping units. On most maps detailed enough to be useful in planning the management of farms and fields, a mapping unit is nearly equivalent to a soil phase. It is not exactly equivalent, because it is not practical to show on such a map all the small, scattered bits of soil of some other kind that have been seen within an area that is dominantly of a recognized soil phase.

Some mapping units are made up of soils of different series, or of different phases within one series. One such kind of mapping unit, the soil complex, is shown on the soil map of Alamosa Area.

A soil complex consists of areas of two or more soils, so intermingled or so small in size that they cannot be shown separately on the soil map. Each area of a complex contains some of each of the two or more dominant soils, and the pattern and relative proportions are about the same in all areas. The name of a soil complex consists of the names of the dominant soils, joined by a hyphen. San Luis-Corlett complex, undulating, is a complex in the Alamosa Area.

In most areas surveyed there are places where the soil material is so rocky, so shallow, or so severely eroded that it cannot be classified by soil series. These places are shown on the soil map and are described in the survey, but they are called land types and are given descriptive names. Dune land is a land type in the Alamosa Area.

While a soil survey is in progress, samples of soils are taken, as needed, for laboratory measurements and for engineering tests. Laboratory data from the same kinds of soil in other places are assembled. Data on yields of crops under defined practices are assembled from farm records and from field or plot experiments on the same kinds of soil. Yields under defined management are estimated for all the soils.

But only part of a soil survey is done when the soils have been named, described, and delineated on the map and the laboratory data and yield data have been assembled. The mass of detailed information then needs to be organized in such a way as to be readily useful to different groups of users, among them farmers, managers of woodland and rangeland, and engineers.

On the basis of yield and practice tables and other data, the soil scientists set up trial groups. They test these groups by further study and by consultation with farmers, agronomists, engineers, and others. Then they adjust the groups according to the results of their studies and consultation. Thus, the groups that are finally evolved reflect up-to-date knowledge of the soils and their behavior under present methods of use and management.

The general soil map at the back of this survey shows, in color, the soil associations in the Alamosa Area. A soil association is a landscape that has a distinctive proportional pattern of soils. It normally consists of one or more major soils and at least one minor soil, and it is named for the major soils. The soils in one association may occur in another, but in a different pattern.

A map showing soil associations is useful to people who want a general idea of the soils in an area, who want to compare different parts of an area, or who want to know the location of large tracts that are suitable for a certain kind of land use. Such a map is a useful general guide in managing a watershed, a wooded tract, or a wildlife area or in planning engineering works, recreational facilities, and community developments. It is not a suitable map for planning the management of a farm or field or for selecting the exact location of a road, building or similar structure, because the soils in any one association ordinarily differ in slope, depth, stoniness, drainage, and other characteristics that affect their management.

The soil associations in the Alamosa Area are discussed in the following pages.

1. Gunbarrel-Mosca-San Luis Association

Deep, Nearly Level, Well-drained to Poorly Drained, Coarse Textured to Moderately Coarse Textured Soils

This soil association consists of intensively farmed, nearly level soils in the northwestern part of the survey area (fig. 2). There are no creeks or large drainageways through the association. The soils of this association all formed in alluvial material. The vegetation in unfarmed areas consists

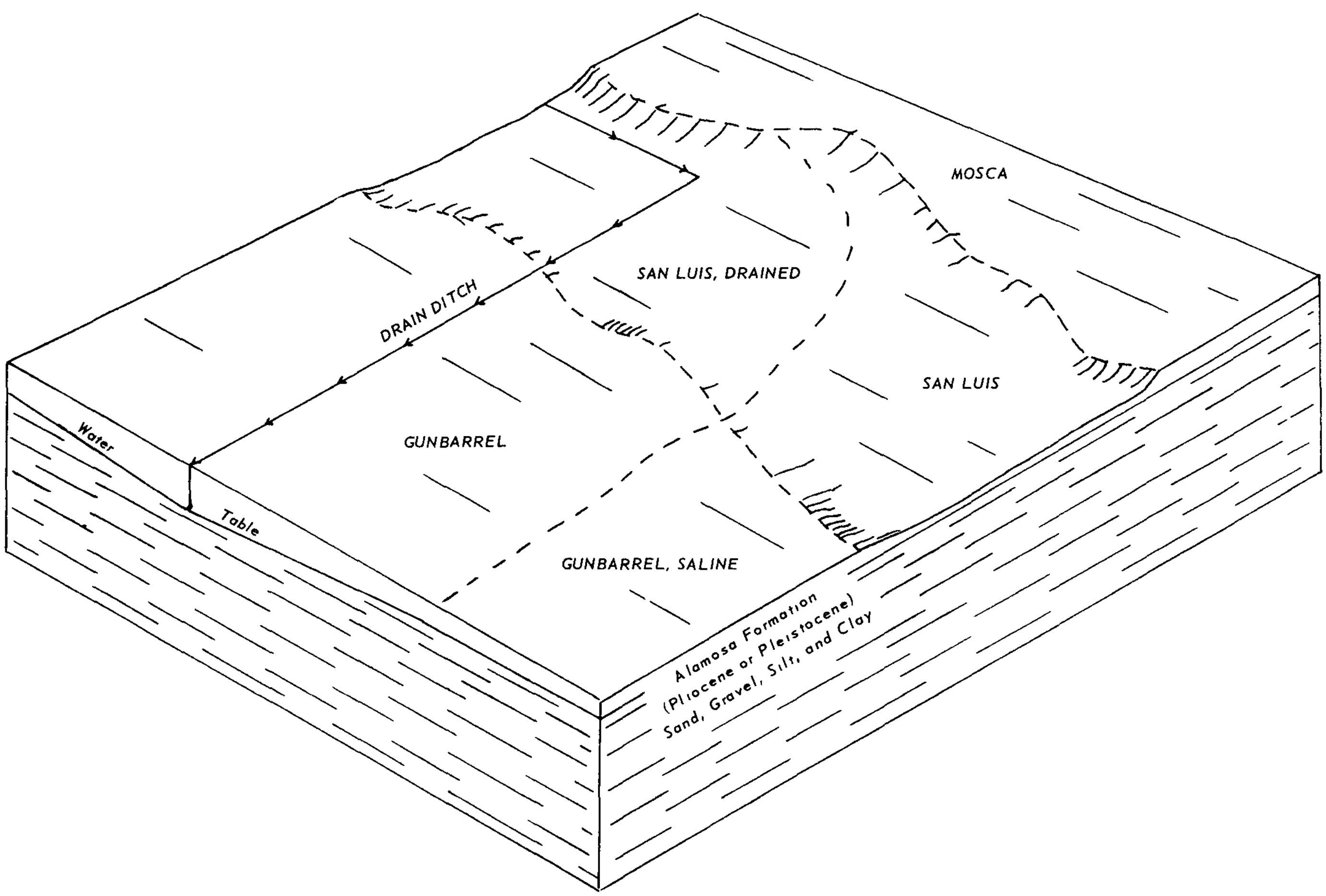


Figure 2.--Diagram showing relationship of the soils in Gunbarrel-Mosca-San Luis association and the effect that drainage has on the water table and soil salinity.

of greasewood, rabbitbrush, alkali sacaton, and inland saltgrass.

This association covers about 20 percent of the survey area. About 50 percent of the association is Gunbarrel soils, about 25 percent is Mosca soils, and nearly 25 percent is San Luis soils. Small areas of Arena and Hooper soils make up less than 1 percent of the association.

The Gunbarrel soils are the most important sub-irrigated soils in the survey area. They are deep, coarse-textured soils that have a high water table during a large part of the year. Many areas are saline.

The Mosca soils also are important to farming. These soils have a coarse-textured surface layer and a moderately coarse textured subsoil. They are underlain by sand and gravel at a depth ranging from 20 inches to more than 36 inches.

The San Luis soils normally occur in slightly depressed areas. These soils have a moderately coarse textured surface layer and a moderately fine textured subsoil. They are underlain by sand at a depth ranging from 24 to 40 inches. They are saline and alkali and have a high water table that retards plant growth unless the soil has been drained.

The soils in this association are used mainly for irrigated crops. The main crops are potatoes, barley, alfalfa, and oats. This association is the main potato-growing area in the survey area. Most farms range from 160 to 480 acres in size. Land that is not farmed is used for grazing.

2. McGinty-Gunbarrel Association

Deep, Nearly Level, Well-drained and Somewhat Poorly Drained, Moderately Coarse Textured to Coarse Textured Soils

This soil association consists of intensively farmed soils in the northern part of the survey area. It occurs in two small areas, one of which is in the northern part of the county on the Hooper Ridge. The other area is in the vicinity of Mosca. It is slightly higher in elevation than the surrounding soils and is less affected by a high water table. The vegetation in small unfarmed areas consists of rabbitbrush, alkali sacaton, and inland saltgrass.

This association covers about 4 percent of the survey area. About 60 percent of the association is McGinty soils, about 25 percent is Gunbarrel soils, and about 15 percent is Mosca soils.

The McGinty soils are deep and have a moderately coarse textured surface layer and subsoil. They have a moderately coarse textured substratum and a high-lime zone in the upper part of the substratum. These soils are well drained.

The Gunbarrel soils are deep, coarse-textured soils that have a high water table in some places during part of the year.

The soils in this association are used mainly for irrigated crops. The main crops are potatoes, barley, oats, and alfalfa. Most farms range from 160 to 320 acres in size. Land that is not farmed is used for grazing.

3. Alamosa-Vastine-Alluvial land Association

Deep, Nearly Level, Moderately Well Drained to Poorly Drained, Moderately Fine Textured to Coarse-textured Soils

This soil association consists of the dark-colored alluvial soils on the low flood plains that border the Rio Grande River and Alamosa, LaJara, and Rock Creeks (fig. 3). The soils are nearly level or undulating, and there are many old stream channels and sloughs. A large part of this general area is flooded in spring when rivers and creeks are high. Other parts of the association that are not flooded have a high water table and are saline or affected by alkali. The vegetation in most places along the river consists of cottonwood trees and willows with an understory of grasses. The areas that are adjacent to this band of trees and the areas that border LaJara, Alamosa, and Rock Creeks have a thick stand of sedges, rushes, and water-tolerant grasses. Farther away from the river and the creeks, in areas that are not so frequently flooded, the vegetation is greasewood, rabbitbrush, alkali sacaton, and inland saltgrass.

This association covers about 12 percent of the survey area. About 24 percent of the association is Alamosa soils, about 13 percent is Vastine soils, about 20 percent is Loamy alluvial land and Wet alluvial land, and about 7 percent is Sandy alluvial land. Minor soils make up the remaining 36 percent of the association.

The Alamosa soils are deep, dark-colored, somewhat poorly drained soils. These soils have a medium-textured surface layer and a moderately fine textured subsoil. They have a water table that restricts the growth of some crops unless the soil has been drained. Some areas are saline.

The Vastine soils occur along Rock, Alamosa, and LaJara Creeks and the southern part of the Rio Grande River. These soils have a black, medium-textured surface layer and a moderately fine textured subsoil, and they are underlain by sand at a depth of 24 to 40 inches. They have a high water table that causes the soils to be wet. Many areas of these soils are flooded during the spring when creeks are high.

Loamy alluvial land and Wet alluvial land are medium textured to moderately fine textured and range from 20 to 60 inches thick over sand. These soils have a high water table during much of the year. They are subject to flooding in many places when the river is high.

Sandy alluvial land occurs adjacent to the Rio Grande River. In most places it supports cottonwood trees and willows. The soils are sandy, have many gravel bars, and consist of highly variable material. They are subject to flooding and deposition of new material when the river is high.

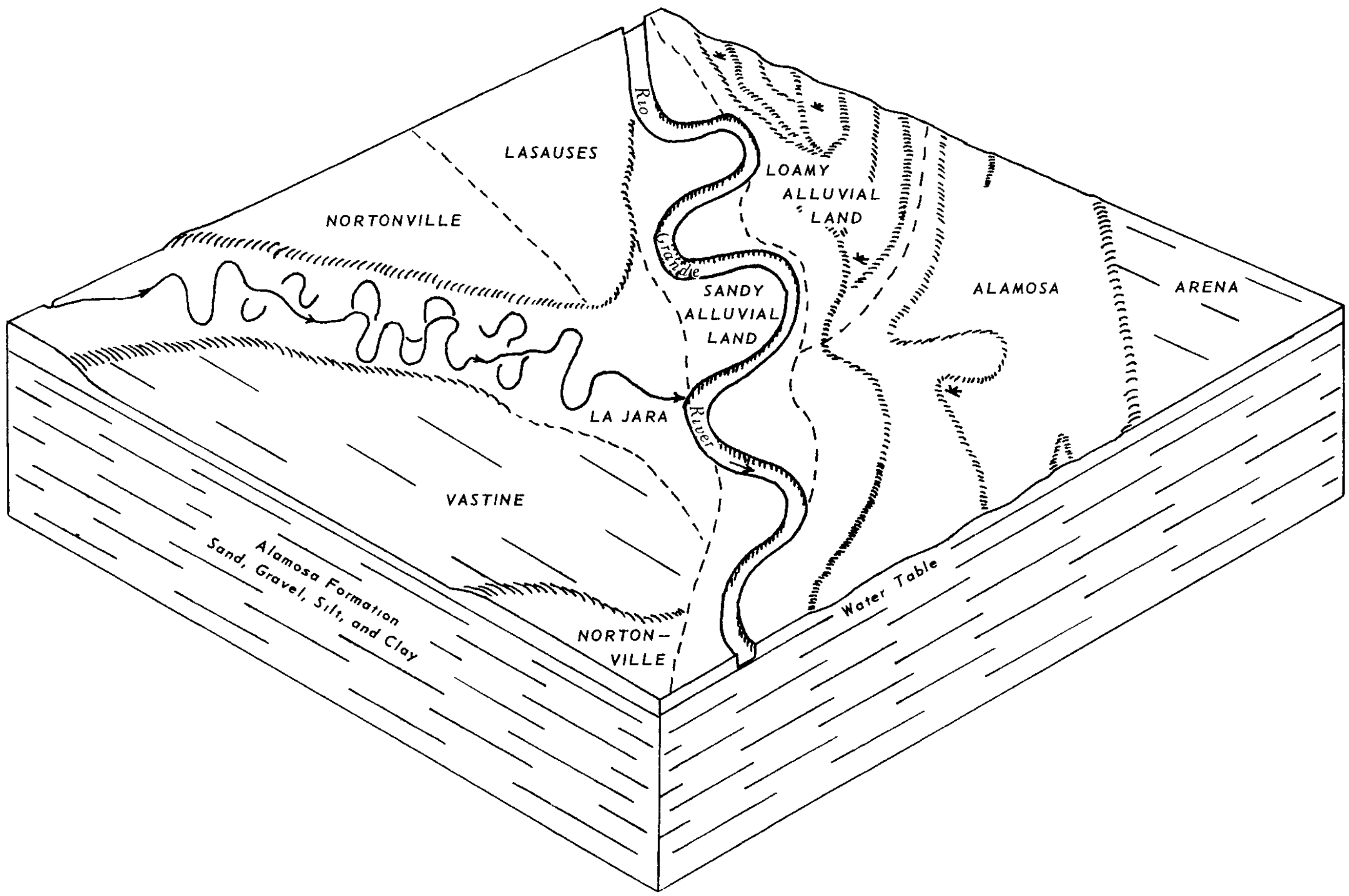


Figure 3.--Diagram showing relationship of the soils in the Alamosa-Vastine-Alluvial land association and their proximity to the Rio Grande River and to creeks.

LaJara, LaSauses, Arena, Nortonville, and Homelake soils are among the minor soils. Marsh and river channels also occupy part of the association. The LaJara soils make up about 10 percent of the association; they occur near creek channels in the southern part of the survey area and are often flooded in spring. There are many old creek channels in areas of these soils. The LaSauses soils are nearly level and poorly drained. They make up about 8 percent of the association and occur in the southern part of the survey area. Arena and Nortonville soils make up about 10 percent of the association. These soils are along Rock and Alamosa Creeks and the Rio Grande River in positions that are not flooded from high water in the river and creeks. They have a high water table during much of the year. The Homelake soils are in the western part of the association. They occupy about 3 percent of the association and are near the Rio Grande River.

The soils in this association are used for irrigated meadow, irrigated crops, and range. The strongly saline or very wet soils are mostly used for pasture and irrigated meadow. Irrigated meadows are cut for hay or used for grazing. Some areas that are not excessively saline are used for irrigated crops. The most common crops are barley, oats, and alfalfa. The Sandy alluvial land along the river is used mainly for grazing. Most farms range from 160 to 320 acres in size. Operating units that are principally ranch units average about 1,000 acres in size.

4. San Arcacio-Acacio-Zinzer Association

Nearly Level to Gently Sloping, Moderately Well Drained and Well Drained, Moderately Coarse Textured and Medium-Textured Soils; Some Moderately Deep Over Gravel and Sand, Others Deep

This soil association consists of intensively farmed soils in the southwestern part of the survey area. It is a highly productive, irrigated area. This association consists of a series of low terrace ridges that are nearly level and range from 1/4 mile to 2 miles in width. Between these ridges are low flood plains or drainage areas that are nearly level and range in width from 1/4 mile to 2 miles in width. The ridges are about 10 to 15 feet higher than the low areas between them. The vegetation in unfarmed areas consists of greasewood, rabbitbrush, alkali sacaton, and inland saltgrass.

This association covers about 11 percent of the survey area. About 46 percent of the association is San Arcacio soils, about 21 percent is Acacio soils, and about 18 percent is Zinzer soils. Villa Grove soils make up the remaining 15 percent (fig. 4).

The San Arcacio soils are in the low areas between the ridges. They have a moderately coarse textured surface layer and a medium-textured subsoil. Gravel occurs at a depth of 20 to 36 inches. A water table underlies these soils at a depth of 1 to 4 feet.

The Acacio soils are on the ridges, generally toward the edge. These soils have a medium-textured surface layer and a moderately fine textured subsoil. They are deep and have a layer below the subsoil that contains a large amount of gypsum.

The Zinzer soils are deep, medium-textured soils that have a high-lime zone. Sand underlies these soils at a depth ranging from 40 to 60 inches in some places.

The Villa Grove soils are on the ridges.

In some parts of this association, the soils are saline and wet. Most of the association has an extensive drainage system of open drains and tile drains. In areas where the drains function properly, the water table can be controlled and the salts leached out of the soils.

The soils in this association are used mainly for irrigated crops. The main crops are potatoes, barley, oats, alfalfa, cabbage, cauliflower, and lettuce. Most of the irrigated farms range from 80 to 320 acres in size.

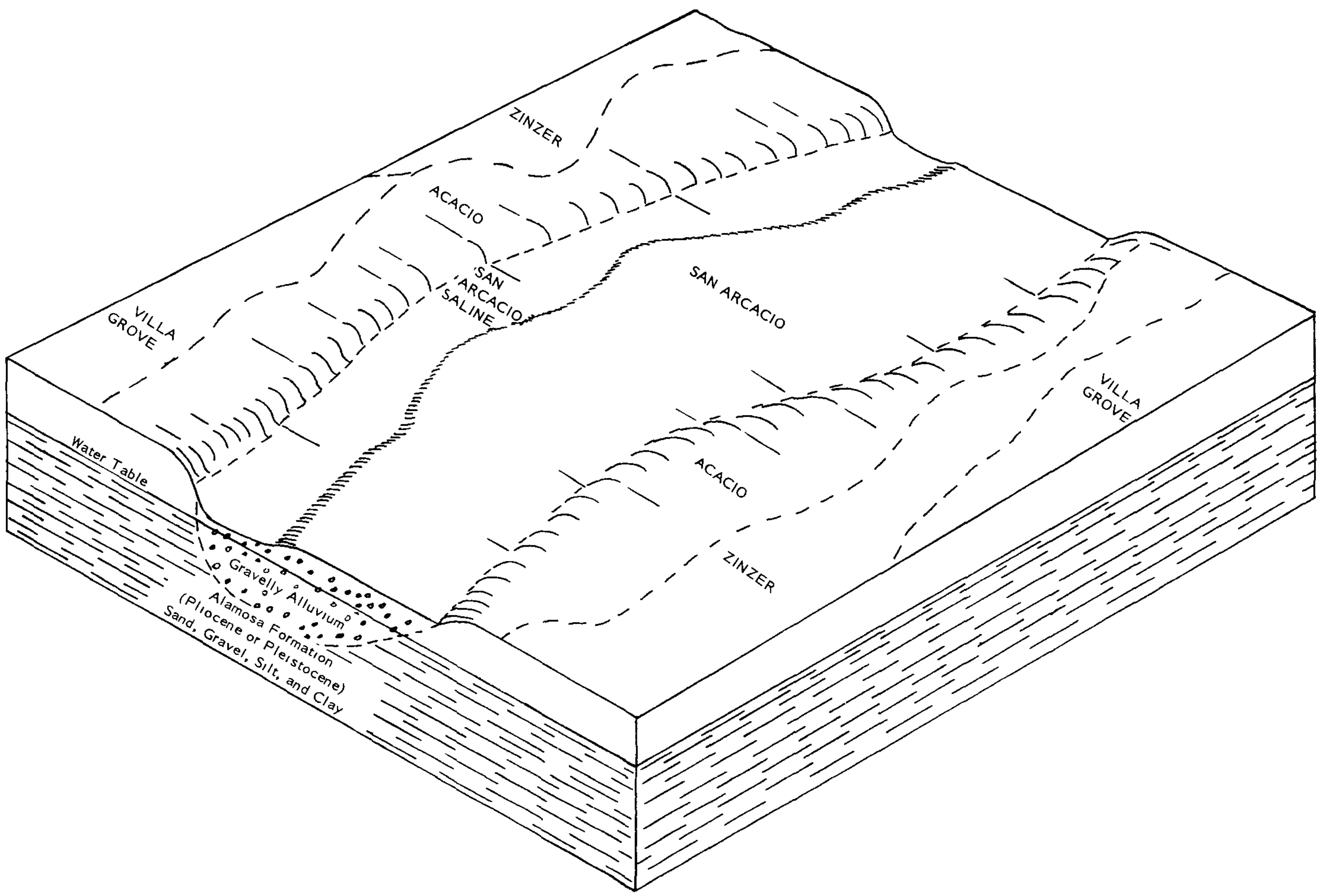


Figure 4.--Diagram showing relationship of the soils in the San Arcacio-Acacio-Zinzer association.

5. Hooper-Corlett Association

Deep, Nearly Level to Hummocky, Well-drained and Somewhat Excessively Drained, Moderately Fine Textured to Coarse-textured Soils that are Strongly Affected by Alkali

This soil association consists of rangeland and is mostly in the eastern and central parts of the survey area (fig. 5). It covers a wide area that extends from the northern to the southern side of the county and contains most of the east-central part of the survey area. Another small area occurs west of the town of Alamosa. The soils formed in alluvial material and wind-deposited sand dunes. The association consists of a nearly level valley floor, and dunes up to 15 feet high cover much of the area. There are many old lakebeds that range from a few acres to 200 or 300 acres in size. Most of the lakebeds are dry, although water gathers in some of them intermittently. There are a few permanent lakes in the association. The vegetation consists of greasewood, rabbitbrush, alkali sacaton, and inland saltgrass. In large areas, however, there is no vegetation except for an occasional greasewood bush.

This association covers about 33 percent of the survey area. About 50 percent of the association is Hooper soils, and about 20 percent is Corlett soils. Minor soils make up the remaining 30 percent.

The Hooper soils are nearly level and in many places are closely intermingled with Corlett or Space City soils. The Hooper soils have a coarse-textured surface layer in some places and a moderately fine textured surface layer in other places. The subsoil is moderately fine textured or fine textured and has very slow permeability. Hooper soils are 20 to 40 inches deep over sand. They are very strongly alkaline, and the moderately fine textured surface layer is dispersed. Water stands on these dispersed soils for several days after rainfall.

The Corlett soils are deep, coarse-textured, very strongly alkaline soils that occur in the dune areas. In most places these soils are closely intermingled with Hooper or San Luis soils.

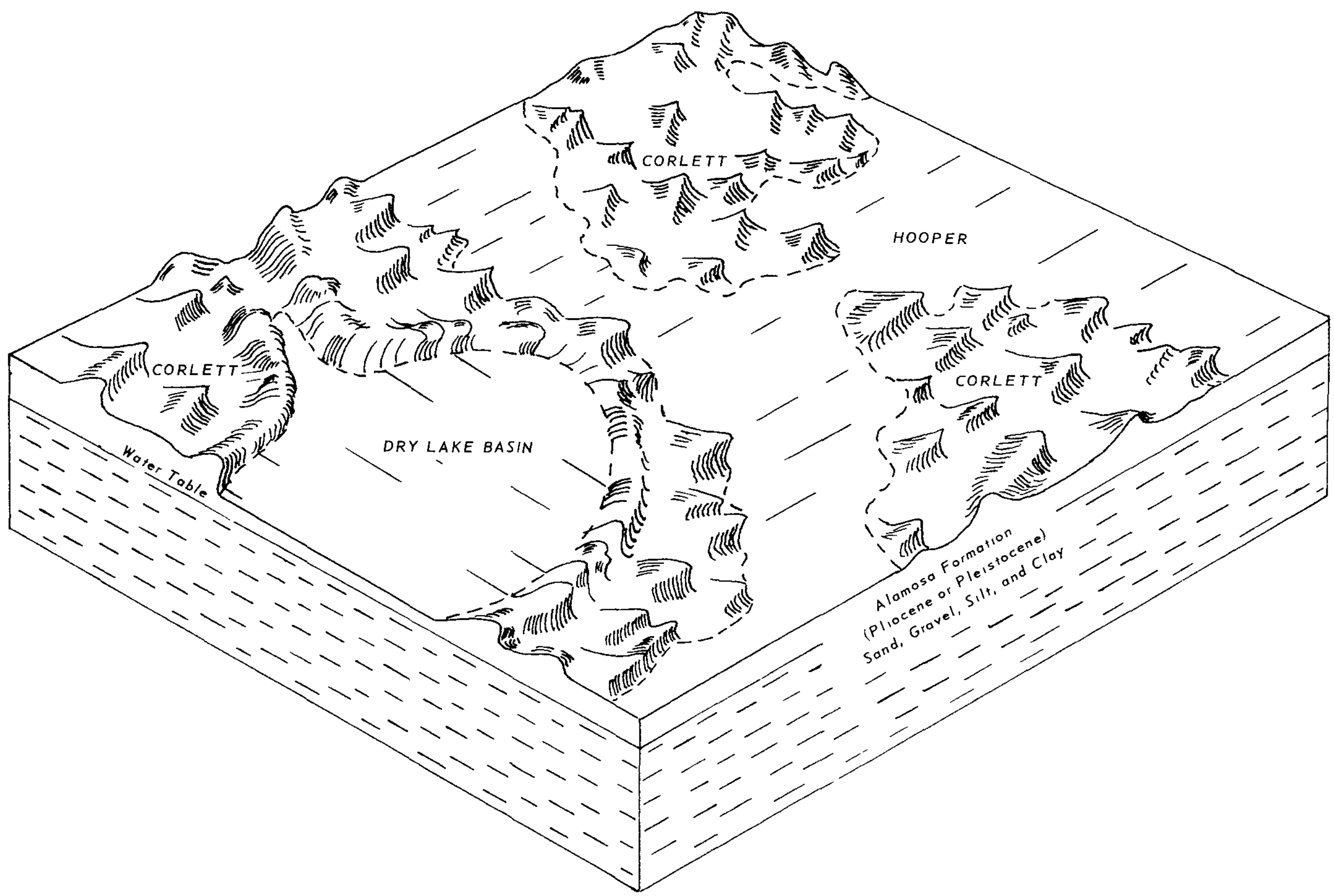


Figure 5.--Diagram showing relationship of the soils in the Hooper-Corlett association and the occurrence of a dry lake basin in the association.

Space City and Laney soils are among the minor soils in this association. The Space City soils are mostly in the eastern part of the association and occupy some of the higher dunes and ridges. Most areas of Space City soils are in intricate patterns with Hooper soils. The Laney soils are in large areas, mostly in the eastern part of the association, and are nearly level.

A small acreage of San Luis and Hapney soils occurs in this association. The San Luis soils are mostly intermingled with Corlett soils.

The soils in this association are used mainly for grazing. Stock water is obtained from artesian wells. There are many small ponds and water areas around the artesian wells that make good nesting areas for ducks. These water areas also are good for duck hunting. Ranch units are large.

6. Costilla-Space City Association

Deep, Nearly Level to Gently Sloping, Somewhat Excessively Drained, Coarse-textured Soils

This soil association makes up a narrow strip in the eastern part of the survey area. The soils are nearly level to gently sloping. There is very little runoff, and most of the rain enters the rapidly permeable soils. The vegetation is mainly small rabbitbrush, blue grama, and Indian ricegrass. In addition, one alkali soil in this association supports greasewood.

This association makes up about 4 percent of the survey area. About 40 percent of the association is Costilla soils, about 40 percent is Space City soils, and the remaining 20 percent is Littlebear soils.

The Costilla soils are coarse textured over sand and gravelly sand at a depth ranging from 24 to 48 inches. These soils are very droughty.

The Space City soils are deep, coarse-textured soils that formed in sandy material deposited by wind. These soils also are very droughty.

The Littlebear soils are gently sloping on fans from the Sangre de Cristo Mountains.

The soils in this association are used for grazing. They make up parts of large ranches. A few antelope range over these soils. There is no farmland in this association, although in the early settlement of the Area some attempts were made to farm parts of it. Farming was not successful, because of the droughty soils and lack of irrigation water.

7. Uracca-Mount Home-Comodore Association

Deep to Very Shallow, Sloping to Very Steep, Somewhat Excessively Drained and Well-drained, Medium-textured and Moderately Coarse Textured, Very Cobbly and Stony Soils

This soil association is along the eastern edge of the survey area (fig. 6). It consists of the mountainsides and sloping to moderately steep alluvial fans on the west face of the Sangre de Cristo Mountain Range. The soils here receive more rainfall than soils on the valley floor. Elevations range from about 7,700 feet to about 11,000 feet. The vegetation is mostly pinyon trees and some juniper trees. The north slopes and areas along flowing streams have fir, ponderosa pine, and spruce trees. Grasses are blue grama, Arizona fescue, mountain muhly, and needlegrass. Mountain-mahogany, Apache-plume, rabbitbrush, fringed sage, and other shrubs also occur. The lower parts of the alluvial fans have a cover of grass rather than trees.

This association covers about 5 percent of the survey area. About 40 percent of the association is Uracca soils, about 40 percent is Mount Home soils closely intermingled with Sagauche soils, and the remaining 20 percent is Comodore soils.

The Uracca soils are on the steep alluvial fans that have a cover of pinyon trees. The surface layer is very cobbly loam, and the subsoil is very cobbly clay loam. There are large stones throughout these soils. Many ravines cross the alluvial fans.

The Mount Home soils are very cobbly and sandy soils that lie on the lower parts of the alluvial fans. These soils occur closely with Sagauche soils.

The Comodore soils are very steep soils that are shallow over bedrock. They occupy mountain sides. Many large outcrops of rock occur with these soils. Water runs off Comodore soils very rapidly into the alluvial fans below them.

The soils of this association are used mainly for grazing. Part of the association is too steep and rocky for cattle. Wood is cut from the pinyon trees. In the early settlement of the valley, stands of pinyon were an important source of firewood and fenceposts, and now they are an important habitat for deer. Antelope graze on the lower part of the association, below the tree line.

Many streams originating in the mountains disappear into the cobbly fans of this soil association. Only one creek, Zapata Creek, delivers enough water across the association to be of any use for stock water or irrigation. No other creeks contain enough water to cross the cobbly fans, except during heavy rainfall in the mountains.

8. Hapney-Hooper-Corlett Association

Deep, Nearly Level to Hilly, Moderately Well Drained to Somewhat Excessively Drained, Moderately Fine Textured to Coarse-textured Alkali Soils

This soil association is in the central part of the survey area, northeast of the town of Alamosa. It is nearly level except for a few dunes. There is no external drainage pattern in this association. Precipitation either soaks into the soils or evaporates. The vegetation consists of greasewood, rabbitbrush, western wheatgrass, alkali sacaton, and inland saltgrass.

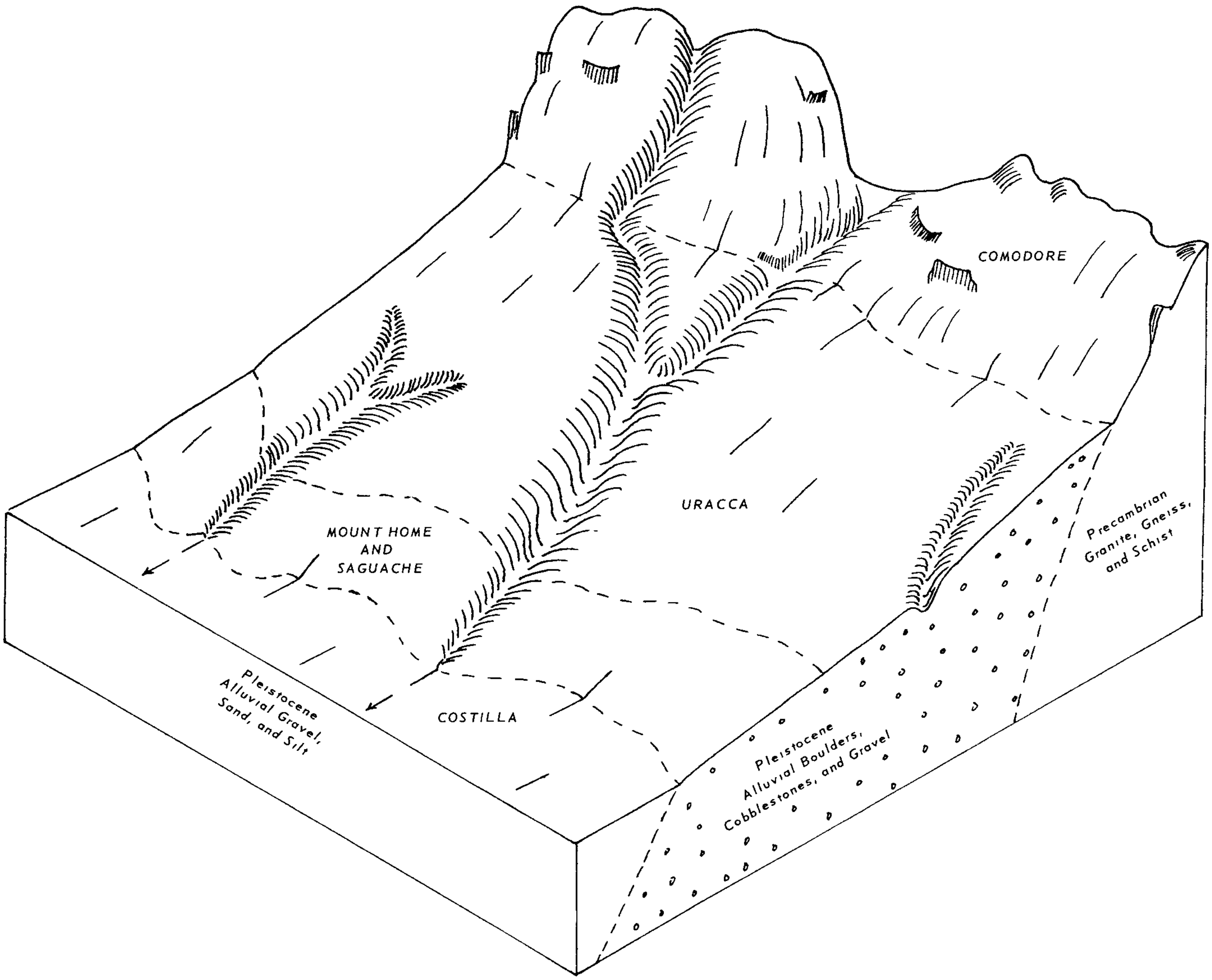


Figure 6.--Diagram showing relationship of the soils in the Uracca-Mount Home-Comodore association.

This association covers about 6 percent of the survey area. About 35 percent of the association is Hapney soils, about 25 percent is Hooper soils, and about 10 percent is Corlett soils. Minor soils make up the remaining 30 percent.

The Hapney soils are nearly level and strongly alkali. These soils have a moderately fine textured surface layer and a moderately fine textured to fine textured subsoil. They have a sand substratum at a depth of 40 to 60 inches.

The Hooper soils are nearly level. In many places they are closely intermingled with Corlett soils. The Hooper soils have a coarse-textured surface layer in some places and a moderately fine textured surface layer in other places. They have a moderately fine textured or fine textured subsoil that is very slowly permeable. The soils are 20 to 40 inches deep over sand. They are very strongly alkali, and the moderately fine textured surface layer is dispersed.

The Corlett soils are deep, coarse-textured, very strongly alkali soils that occur in the dune areas. These soils occur closely with Hooper soils.

San Luis, Alamosa, and Arena soils, Loamy alluvial land, and Wet alluvial land are among the minor soils of this association.

About one-third of this association is irrigated farmland. Most of the irrigated farming is on the Hapney soils and on Loamy alluvial land. These soils are not so strongly alkali as Hooper soils. The main crops are barley, oats, and alfalfa. Land that is not irrigated is used for grazing. Most

of the farms in this association range from 320 to 480 acres in size.

9. Cotopaxi-Dune land Association

Deep, Rolling to Hilly, Excessively Drained, Coarse-textured Soils

This soil association occurs in the northeastern corner of the survey area. It is dunelike, and some of the sand dunes are as much as 600 feet high. Because rainwater penetrates the soils rapidly, there is no runoff. The parent material is wind-deposited sand that has been blown up from the valley floor. The vegetation on the Cotopaxi soils consists of Indian ricegrass, spiny muhly, and little rabbitbrush. On these soils the cover of vegetation is sparse in most places. Dune land is bare, and the sand shifts easily with the wind.

This association covers about 5 percent of the survey area. About 75 percent of the association is Cotopaxi soils, and about 25 percent is Dune land.

The Cotopaxi soils are deep, coarse textured, and noncalcareous. They are droughty and rapidly permeable and are highly erodible if vegetation is destroyed.

Most of Dune land is in one large area and is not intermingled with other soils of the association.

The soils of this association are used for grazing and recreation. Most of Dune land is in the Great Sand Dunes National Monument and is an attraction for tourists. The Cotopaxi soils that are outside the boundary of the national monument are used for grazing. Private lands are part of large ranch units.

DESCRIPTIONS OF THE SOILS

In this section the soils of Alamosa Area are described in detail. The procedure is to describe first the soil series and then the mapping units, or kinds of soil, in that series. Thus, to get full information on any one mapping unit, it is necessary to read both the description of that unit and the description of the soil series to which the unit belongs.

Each soil series description contains a short narrative description of a profile considered representative of the series, and a much more detailed description of the same profile that scientists, engineers, and others can use in making highly technical interpretations. In all the descriptions except the detailed, the colors given are for moist soils unless otherwise noted. In each detailed description, the colors are for dry soil unless otherwise noted.

Some of the terms used in the soil descriptions are defined in the Glossary, and some are defined in the section "How This Survey Was Made." The approximate acreage and proportionate extent of each soil mapped are shown in table 1. At the back of this soil survey is the "Guide to Mapping Units," which lists the mapping units in the county and shows the capability unit (irrigated, nonirrigated, or both) and range site each mapping unit is in, and the page where each of these groups is described.

Acacio Series

The Acacio series consists of well-drained, slightly saline to moderately saline soils that have a high concentration of gypsum. These soils are on alluvial flood plains in the southern part of the survey area. In places they are seeped by irrigation and have a seasonal high water table. They formed in medium-textured, calcareous, alluvial material.

In a representative profile in range cover, the surface layer is very dark grayish-brown heavy sandy loam that is noncalcareous, strongly alkaline, and about 4 inches thick. In cultivated fields, the surface layer is loam about 6 inches thick. The subsoil is dark-brown clay loam in the upper 3 inches and dark grayish-brown sandy clay loam in the lower 3 inches. It is moderately calcareous and moderately alkaline to strongly alkaline, and it contains small spots of salt that increase in number in the lower part. The upper 34 inches of the substratum consists of brown and light yellowish-brown loam that is slightly calcareous to moderately calcareous, is moderately alkaline, and contains about 40 percent fine crystalline gypsum in the lower part. The lower part of the substratum is dark yellowish-brown clay loam that has mottles of yellowish brown, has small nodules of lime throughout, is moderately alkaline, and extends to a depth of 60 inches or more.

Acacio soils have moderate permeability to a depth of 40 inches and moderately slow permeability below that depth. They have moderate to high available water holding capacity. Plant roots may extend to a depth of 60 inches or more in these soils.

The vegetation consists of big rabbitbrush, greasewood, saltgrass, and alkali sacaton. These soils are used for irrigated crops, pasture, and range.

Representative profile of Acacio loam, 0 to 1 percent slopes, 1,320 feet west and 36 feet south of the northeast corner of sec. 11, T. 36 N., R. 9 E.:

A1--0 to 4 inches, grayish-brown (10YR 5/2) heavy sandy loam, very dark grayish brown (10YR 3/2) when moist; weak, thick, platy structure parting to moderate, fine, granular; slightly hard when dry, very friable when moist; noncalcareous; pH 8.6; abrupt, smooth boundary.

TABLE 1.--APPROXIMATE ACREAGE AND PROPORTIONATE EXTENT OF THE SOILS

Soil	Area	Extent
	Acres	Percent
Acacio loam, 0 to 1 percent slopes	2,831	0.6
Acacio loam, 1 to 3 percent slopes	388	(1/)
Acacio loam, saline, 0 to 1 percent slopes	1,313	.3
Alamosa loam	8,100	1.9
Alamosa loam, saline	4,251	1.0
Arena loam	5,146	1.2
Arena loam, drained	3,045	.7
Comodore extremely rocky loam, 40 to 150 percent slopes	3,849	.9
Corlett sand, hilly	2,659	.6
Corlett-Hooper complex, undulating	29,965	6.9
Costilla loamy sand, 0 to 2 percent slopes	7,417	1.7
Cotopaxi sand, hilly	17,392	4.0
Dune land	4,993	1.1
Graypoint-Gravelly land complex, 0 to 2 percent slopes	4,873	1.1
Gunbarrel loamy sand	43,955	10.1
Gunbarrel loamy sand, saline	8,480	1.9
Hapney loam	7,967	1.8
Homelake loam	1,225	.3
Hooper loamy sand	34,850	8.0
Hooper clay loam	16,238	3.7
Hooper soils, occasionally flooded	4,513	1.0
LaJara loam	3,366	.8
Laney loam	10,222	2.3
LaSauses sandy clay loam	4,378	1.0
Littlebear sandy loam, 3 to 6 percent slopes	2,592	.6
Loamy alluvial land	5,312	1.2
Marsh	1,586	.3
McGinty sandy loam	9,388	2.1
McGinty sandy loam, saline	1,430	.3
Medano fine sandy loam	2,934	.7
Mosca loamy sand	30,651	7.0
Mosca loamy sand, wet	6,143	1.4
Mount Home-Saguache cobbly sandy loams, 4 to 12 percent slopes	8,994	2.0
Nortonville loam	3,425	0.8
Peat	304	(1/)
San Arcacio sandy loam	10,205	3.3
San Arcacio sandy loam, saline	6,567	1.5
Sandy alluvial land	3,799	.8
San Luis sandy loam	20,022	4.6
San Luis sandy loam, drained	6,006	1.4
San Luis-Corlett complex, undulating	9,434	2.2
San Luis-Gravelly land complex	1,722	.4
Space City loamy fine sand, 0 to 3 percent slopes	7,856	1.8
Space City loamy fine sand, alkali substratum, 0 to 3 percent slopes	21,224	4.9
Space City-Hooper complex, hilly	7,814	1.8
Uracca very cobbly loam, 15 to 35 percent slopes	8,500	1.9
Vastine loam	6,830	1.5
Villa Grove sandy clay loam, 0 to 1 percent slopes	2,539	.6
Villa Grove sandy clay loam, saline, 0 to 1 percent slopes	2,403	.5
Villa Grove sandy clay loam, saline, 1 to 3 percent slopes	817	.1
Wet alluvial land	4,145	.9
Zinzer loam, 0 to 1 percent slopes	2,529	.6
Zinzer loam, 1 to 3 percent slopes	934	.2
Zinzer loam, saline, 0 to 1 percent slopes	3,268	.7
River and creek channels	1,190	.3
Permanent lakes and ponds	2,204	.5
Gravel pits	145	(1/)
Total	434,328	100.0

1/ Less than 0.1 percent.

B21t--4 to 7 inches, brown (10YR 5/3) clay loam, dark brown (10YR 3/3) when moist; weak to moderate, medium, subangular blocky structure parting to moderate, medium, granular; hard when dry, firm when moist; thin patchy clay skins; moderately calcareous; pH 8.8; small salt spots common; clear, wavy boundary.

B22tsa--7 to 10 inches, brown (10YR 5/3) sandy clay loam, dark grayish brown (10YR 4/2) when moist; weak to moderate, medium, subangular blocky structure parting to weak, medium, granular; hard when dry, firm when moist; thin patchy clay skins; moderately calcareous; pH 8.4; numerous small salt spots; clear, wavy boundary.

C1--10 to 16 inches, pale-brown (10YR 6/3) loam; brown (10YR 5/3) when moist; very weak, coarse, subangular blocky structure parting to weak, fine, granular; slightly hard when dry, friable when moist; moderately calcareous; pH 8.4; abrupt, wavy boundary.

C2cs--16 to 44 inches, very pale brown (10YR 7/3) gypsiferous loam, light yellowish brown (10YR 6/4) when moist; massive; soft when dry, very friable when moist; slightly calcareous; pH 8.0; horizon is weakly stratified with clay loam and contains about 40 percent crystalline gypsum; gradual, smooth boundary.

C3--44 to 60 inches, light yellowish-brown (10YR 6/4) clay loam, dark yellowish brown (10YR 4/4) when moist, yellowish brown (10YR 5/4) when crushed; massive; hard when dry, firm when moist; common yellowish-brown (10YR 5/8) mottles; noncalcareous matrix, but has nodules of lime throughout; pH 8.0.

The A horizon ranges from 4 to 9 inches in thickness and is heavy sandy loam or sandy clay loam in texture. The B horizon ranges from 6 to 10 inches in thickness and has a slight to moderate concentration of lime. The high concentration of gypsum normally starts within a depth of 20 inches, and the amount varies from 5 to 40 percent of fine crystalline gypsum. The size and concentration of the crystals generally increase with depth. The pH value ranges from 8.5 to 9.0 in the A horizon, from 7.9 to 9.0 in the B horizon, and from 7.4 to 8.4 in the C horizon. The soils range from nonsaline in some irrigated areas to strongly saline in some range areas.

Acacio loam, 0 to 1 percent slopes (AaA).--This soil occupies moderately extensive areas on flood plains or extensions of old alluvial terraces in the southwestern part of the survey area. It has the profile described as representative for the Acacio series. Small depressed areas are common and may be the result of the gypsum dissolving and allowing the soil to settle in places. Surface runoff is slow. The hazard of soil blowing is slight to moderate in nonirrigated areas if vegetative cover is not maintained.

Included in mapping are small areas where high concentrations of gypsum may occur within a depth of 10 inches, particularly in fields that have been leveled. Some small areas of Zinzer loam, 0 to 1 percent slopes and of Villa Grove soils also are included.

This soil is used for all locally adapted crops, but alfalfa and small grains are better suited than other crops. Capability units IIIs-1 (irrigated) and VIIs-3 (nonirrigated); Salt Flats range site.

Acacio loam, 1 to 3 percent slopes (AaB).--This soil occupies the edges of long, low narrow terrace ridges that border low flat areas that are generally 10 to 15 feet lower in elevation than the ridges. This soil is slightly saline to moderately saline. Surface runoff is medium. The hazard of soil blowing is slight to moderate in nonirrigated areas if vegetative cover is not maintained.

All irrigated crops adaptable to the survey area can be grown on this soil, but because of slope, the soil is better suited to alfalfa and small grains than to other crops. Vegetable crops are not grown. If properly managed, this soil is well suited to permanent pasture and hay. Capability units IIIe-1 (irrigated) and VIIs-3 (nonirrigated); Salt Flats range site.

Acacio loam, saline, 0 to 1 percent slopes (AcA).--This soil occupies alluvial flood plains and is affected by a high water table. This soil has a profile similar to the one described as representative for the Acacio series, except that it is seeped by irrigation water, is moderately saline to strongly saline, and has a fluctuating water table at a depth between 2 1/2 to 5 feet. Uncultivated areas have more greasewood and more free salt accumulation on the surface than less saline soils of the Acacio series. Surface runoff is slow. The hazard of erosion is slight.

Potatoes, vegetables, and alfalfa are reduced in growth by the salts and high water table. Salt- and water-tolerant plants are necessary for pasture and hay planting. Capability units IIIsw-1 (irrigated) and VIw-2 (nonirrigated); Salt Flats range site.

Alamosa Series

The Alamosa series consists of somewhat poorly drained soils on the low flood plain along the Rio Grande River. These soils formed in medium-textured to moderately fine textured alluvial material. They are in positions that are flooded from high water in the river.

In a representative profile, the surface layer is very dark gray loam about 8 inches thick. This layer is noncalcareous and is moderately alkaline. The subsoil is very dark gray clay loam or sandy clay loam about 37 inches thick. It is slightly calcareous to moderately calcareous and is moderately alkaline. The substratum, to a depth of about 55 inches, is dark-brown loam. Below this is dark-brown, mottled sand that continues to a depth of more than 60 inches. It is noncalcareous and is mildly alkaline.

Alamosa soils have moderately slow permeability and moderate to high available water holding capacity. Many areas are close to the river and are subject to overflow during periods of heavy runoff. These soils have a water table that fluctuates between depths of 1 and 4 feet during different seasons. The water table is nearer the surface in spring and summer than in fall and winter. Depth of plant rooting normally is limited by depth to the water table.

The vegetation consists of sedges, rushes, sloughgrass, alkali sacaton, and saltgrass. These soils are used for irrigated crops, meadow, and range.

Representative profile of Alamosa loam, 150 feet west and 90 feet south of the northeast corner of sec. 24, T. 38 N., R. 9 E.:

A11--0 to 3 inches, gray (10YR 5/1) loam, very dark gray (10YR 3/1) when moist; weak, medium, platy structure parting to fine, granular; slightly hard when dry, friable when moist; noncalcareous; pH 7.9; clear, smooth boundary.

A12--3 to 8 inches, gray (10YR 5/1) loam, very dark gray (10YR 3/1) when moist; very weak, medium, subangular blocky structure; hard when dry, friable when moist; noncalcareous; pH 8.0; clear, smooth boundary.

B21t--8 to 15 inches, gray (10YR 5/1) clay loam, very dark gray (10YR 3/1) when moist; weak, coarse, prismatic structure parting to moderate, medium and coarse, angular and subangular blocky; hard when dry, friable when moist; slightly calcareous; pH 8.2; thin continuous clay skins; few salt spots; gradual, smooth boundary.

B22t--15 to 24 inches, gray (10YR 5/1) sandy clay loam, very dark gray (10YR 3/1) when moist; weak to moderate, medium, subangular blocky structure; hard when dry, firm when moist; moderately calcareous, with many lime and salt spots; pH 8.4; common, medium, faint mottles of grayish brown (10YR 5/2); thin patchy clay skins; gradual, smooth boundary.

B3cag--24 to 45 inches, gray (10YR 5/1) clay loam, very dark gray (10YR 3/1) when moist; weak, medium, subangular blocky structure; hard when dry, firm when moist; common, medium, distinct mottles of yellowish brown (10YR 5/6); moderately calcareous; pH 8.4; few, thin, patchy clay skins; some lime and salt spots; gradual, smooth boundary.

C1--45 to 55 inches, brown (10YR 5/3) loam, dark brown (10YR 4/3) when moist; massive; slightly hard when dry, very friable when moist; noncalcareous; pH 7.8; clear, smooth boundary.

C2g--55 to 65 inches, brown (10YR 5/3) sand, dark brown (10YR 4/3) when moist; single grain; noncalcareous; pH 7.6; common, medium, faint, brown (7.5YR 4/4) mottles and common, medium, distinct, dark-gray (5YR 4/1) mottles.

The texture of the A horizon ranges from loam to clay loam, and its thickness ranges from 6 to 9 inches. The B horizon is 20 to about 40 inches thick. The depth to sand ranges from 40 inches to about 60 inches. The soil commonly is noncalcareous in the A horizon but may be calcareous below.

Alamosa loam (0 to 1 percent slopes) (Am).--This soil occupies low areas along the river that are subject to flooding in spring when there is high runoff from snow melting in the mountains. Areas that have not been leveled in farming operations are undulating, with many old river channels, oxbows, and swale areas. Some of the lower swale areas have water in them during most of the irrigation season. This soil has the profile described as representative for the Alamosa series. Surface runoff is slow. The hazard of erosion is slight.

Included in mapping are many areas of soils that are shallower over sand and gravel than normal Alamosa soils. In these shallow soils, depth to sand and gravel ranges from 20 to 36 inches. In land-leveling operations, deep cuts have exposed sand bars in some places. Some small inclusions of saline and alkali soils occur. These commonly are in higher spots in the fields that are not flooded or irrigated so frequently as this Alamosa soil.

This soil is used mainly for irrigated meadow and irrigated crops. Some small areas are used for range. The irrigated meadows are either cut for hay or used for grazing. The main crops are small grains and alfalfa. This soil is not well suited to potatoes. Vegetable crops are grown to a minor extent. In unfarmed areas the vegetation is a thick stand of sedges, rushes, sloughgrass, and other water-tolerant grasses. Capability units IIIw-1 (irrigated) and Vw-1 (nonirrigated); Wet Meadow range site.

Alamosa loam, saline (0 to 1 percent slopes) (An).--This soil occurs along the low flood plain of the Rio Grande River. In areas that have not been leveled for farming, the surface is undulating and there are many old channels, oxbows, and swales. This soil has a profile similar to the one described as representative for the series, except that it is moderately saline because of the high water table and evaporation from the surface. This soil is not flooded or irrigated so frequently as Alamosa loam, because of its slightly higher position. Surface runoff is slow. The hazard of erosion is slight.

Included in mapping are small areas of soils that are shallower over sand and gravel than this soil. In these included soils, depth to sand and gravel ranges from 20 to 36 inches. In land-leveling operations, deep cuts expose sandbars in some places. In areas of this soil that are farthest from the river, there are inclusions of Hapney loam that make up as much as 10 percent of a given area. These inclusions are alkali affected and result in slickspots and a poor stand of crops.

This Alamosa soil is used mainly for irrigated meadow and irrigated crops. Some areas are used for range. The irrigated meadows are cut for hay or used for grazing. Small grains and alfalfa are grown. This soil is not suitable for potatoes and vegetable crops, because of salinity and wetness.

In unfarmed areas the vegetation is sedges, rushes, alkali sacaton, and saltgrass. Capability unit IIIw-2 (irrigated) and VIw-1 (nonirrigated); Salt Meadow range site.

Arena Series

The Arena series consists of somewhat poorly drained and poorly drained, saline and alkali soils that have a duripan at a depth of 30 to 40 inches. These soils formed in alluvial material on old flood plains of the valley floor.

In a representative profile, the surface layer is brown loam and dark-brown clay loam about 5 inches thick. It is moderately calcareous, very strongly alkaline, and high in content of sodium salts. The next layer is dark grayish-brown clay loam about 8 inches thick. It is moderately calcareous, very strongly alkaline, and extremely high in content of sodium. The upper 10 inches of the substratum is dark-brown clay loam. The next 25 inches consists of layers of dark grayish-brown and brown sandy clay loam. These layers are calcareous in spots and are mottled. They are high in content of exchangeable sodium and contain a strongly cemented to indurated layer in the lower part. Sand is at a depth of about 48 inches.

Arena soils have very slow permeability and moderate to high available water holding capacity, depending on the amount of salts in the soil. Depth of plant rooting is normally limited by the depth to the water table.

The vegetation consists of greasewood and some saltgrass. These soils are used primarily for range. A few drained areas that have salts leached out are used for irrigated crops and pasture.

Representative profile of Arena loam, 1,250 feet east and 950 feet north of the southwest corner of sec. 30, T. 38 N., R. 9 E.:

A11--0 to 2 inches, pinkish-gray (7.5YR 6/2) loam, brown (7.5YR 4/2) when moist; weak, thick, platy structure parting to weak, fine, granular; slightly hard when dry, friable when moist; moderately calcareous; pH 10.1; clear, smooth boundary.

A12--2 to 5 inches, brown (7.5YR 5/2) clay loam, dark brown (7.5YR 3/2) when moist; moderate, fine, granular structure; slightly hard when dry, friable when moist; moderately calcareous; pH 10.3; clear, smooth boundary.

AC--5 to 13 inches, brown (7.5YR 5/2) clay loam, dark grayish brown (10YR 4/2) when moist, grayish brown (10YR 5/2) when moist and crushed; moderate, medium, subangular blocky structure parting to moderate, fine, granular; slightly hard when dry, friable when moist; moderately calcareous; pH 10.2; slickensides very pronounced; horizon has a brittle feel; clear, smooth boundary.

C1--13 to 23 inches, pinkish-gray (7.5YR 6/2) clay loam, dark brown (7.5YR 4/2) when moist; weak to moderate, medium, subangular blocky structure parting to weak to moderate, fine, granular; slightly hard when dry, friable when moist; moderately calcareous; pH 10.0; slickensides very pronounced; very brittle feel; clear, smooth boundary.

C2casa--23 to 33 inches, pale-brown (10YR 6/3) sandy clay loam, dark grayish brown (10YR 4/2) when moist, very dark grayish brown (10YR 3/2) when moist and crushed; weak, medium, subangular blocky structure parting to weak, fine, granular; slightly hard when dry, friable when moist; calcareous in spots; pH 9.8; common, fine, distinct mottles of yellowish brown (10YR 5/6) and dark gray (N 4/0); some slickensides; clear, smooth boundary.

C3sam--33 to 48 inches, pale-brown (10YR 6/3) duripan, brown (10YR 5/3) when moist; massive; calcareous in spots; pH 9.7; strongly cemented to indurated layer that is not softened by acid or water; common, small, black concretions; common, fine, distinct, yellowish-brown (10YR 5/6) mottles; gradual, smooth boundary.

IIC4--48 to 60 inches, varicolored sand; single grain; loose.

The profile is highly stratified but is generally clay loam or sandy clay loam in texture. Depth to sand ranges from 40 to more than 60 inches. The water table fluctuates from within a few inches of the surface to below a depth of 5 feet. The pH value ranges from about 8.8 to 10.5. Content of exchangeable sodium ranges from 30 to 80 percent. The C3sam horizon ranges from strongly cemented in some places to indurated. The hardest part of the C3sam horizon ranges from about 3 inches to 6 inches in thickness.

Arena loam (0 to 1 percent slopes) (Ar).--This nearly level soil is on flood plains throughout the western part of the survey area. It is associated with Hooper, San Luis, and Mosca soils. This soil has the profile described as representative for the Arena series. Depth to the water table is 1 1/2 to 3 feet, and drainage is poor. Surface runoff is slow. The hazard of erosion is slight.

Included in mapping are small areas of Hooper clay loam and small areas of San Luis soils.

This soil is used mainly for grazing. Small tracts in areas of better soils are used for small grains, alfalfa, and salt-tolerant grasses and legumes for pasture. Capability units IIIsw-1 (irrigated) and VIw-2 (nonirrigated); Salt Flats range site.

Arena loam, drained (0 to 1 percent slopes) (As).--This nearly level soil is on flood plains throughout the western part of the survey area. It has a profile similar to the one described as

representative for the Arena series, except that it does not contain strong concentrations of alkali and salts. Depth to sand ranges from 40 to 60 inches. This soil is somewhat poorly drained. The water table is at a depth of 2 1/2 to 5 feet and is nearest to the surface in spring and summer. In most places drainage has been provided, which has resulted in a lower water table than is normal for the series. Surface runoff is slow. The hazard of erosion is slight.

Included in mapping are small areas of Hapney loam, Alamosa loam, and San Luis sandy loam. Also included are areas of Arena loam.

Arena loam, drained, is used mainly for grazing and for irrigated crops. Vegetation consists of saltgrass, alkali sacaton, rabbitbrush, and greasewood. This soil is well suited to alfalfa and small grains, but most crops that are adapted to the area can be grown. This soil is not well suited to potatoes. Capability units IIIw-1 (irrigated) and VIw-2 (nonirrigated); Salt Flats range site.

Comodore Series

The Comodore series consists of well-drained, extremely steep soils on mountain slopes. These soils are underlain by acid igneous and metamorphic rock at a depth of 4 to 16 inches. They are noncalcareous and have many cobblestones and stones throughout the profile and on the surface.

In a representative profile, the surface layer is very dark brown stony loam about 5 inches thick. It is noncalcareous and is slightly acid. The next layer is dark-brown very stony loam about 10 inches thick. It is noncalcareous and is slightly acid. This layer is about 70 percent stones. Below this is granitic and metamorphic bedrock.

Comodore soils have moderate permeability to the bedrock and very low available water holding capacity. Plant roots extend to bedrock.

The vegetation is spruce, ponderosa pine, pinyon, Douglas-fir, and juniper, as well as blue grama, mountain-mahogany, and fringed sage. These soils are used mainly for wildlife habitat.

Representative profile of Comodore extremely rocky loam, 40 to 150 percent slopes, about 0.25 mile west of the southeast corner of sec. 9, T. 28 S., R. 73 W. (north-facing slope):

A1--0 to 5 inches, grayish-brown (10YR 5/2) stony loam, very dark brown (10YR 2/2) when moist; weak to moderate, fine, granular structure; soft when dry, friable when moist; noncalcareous; 30 percent stones; pH 6.5; clear, smooth boundary.

C--5 to 15 inches, brown (7.5YR 5/2) very stony loam; dark brown (7.5YR 3/2) when moist; weak to moderate, fine, granular structure; soft when dry, friable when moist; noncalcareous; pH 6.5; about 70 percent stones; abrupt, smooth boundary.

R--15 inches, acid igneous and metamorphic bedrock.

The color of the surface layer is dark grayish brown on south-facing slopes. These soils range from 4 to 16 inches in depth to bedrock. The content of stones ranges from 20 to 80 percent. The parent material ranges from granite to granitic schist, quartz, and other acid igneous or metamorphic rocks. The pH value is about 6.1 to 6.5.

Comodore extremely rocky loam, 40 to 150 percent slopes (CmF).--This extremely steep soil is on the slopes of Mount Blanca and other mountains along the eastern edge of the survey area. The surface layer is covered with angular stones from the parent material and rounded cobblestones that have washed down or rolled down from adjacent areas.

Outcrops of bedrock make up about 40 percent of the mapping unit. The draws and canyons have large areas of rock outcrops (pl. I, top). Runoff is very rapid. The hazard of erosion is very severe.

Small inclusions of Uracca very cobbly loam occur in areas where the soil is deeper over bedrock.

This Comodore soil is used mainly for wildlife habitat. It is generally too steep and too rocky for cattle grazing. The vegetation is spruce, ponderosa pine, pinyon, and fir trees on north-facing slopes and pinyon and juniper trees on south-facing slopes. Tree growth is too slow and slopes are too steep for commercial use. Both north- and south-facing slopes have blue grama, mountain muhly, mountain-mahogany, fringed sage, and prickly pear. Capability unit VIIIs-1 (nonirrigated); not in a range site.

Corlett Series

The Corlett series consists of somewhat excessively drained, alkali soils. In places these soils are underlain at a depth of more than 40 inches by finer textured sediment or by a buried soil that restricts drainage. They formed in reworked, wind-modified sand material in low dunes. They occur mainly in the northeastern part of the county.

In a representative profile, the surface layer is dark grayish-brown sand about 8 inches thick. It is slightly calcareous and is very strongly alkaline. The substratum is mainly brown sand that is slightly calcareous and very strongly alkaline. This horizon extends to a depth of 5 feet or more.

Corlett soils have rapid permeability and low available water holding capacity. The water table in places is within 3 1/2 feet of the surface. Depth to the water table depends on the height of the dunes. At the tops of dunes, the water table is more than 5 feet below the surface. Roots may penetrate to a depth of 60 inches and more, unless their growth is limited by the water table.

The vegetation consists of greasewood, rabbitbrush, four-wing saltbush, and some saltgrass and alkali sacaton. These soils are used for range and are grazed by cattle and sheep.

Representative profile of Corlett sand, hilly, 300 feet north and 300 feet west of the south quarter corner of sec. 36, T. 40 N., R. 11 E.:

A1--0 to 8 inches, light brownish-gray (10YR 6/2) sand, dark grayish brown (10YR 4/2) when moist; single grain; loose; slightly calcareous; pH 9.8; gradual, smooth boundary.
C1--8 to 24 inches, light brownish-gray (10YR 6/2) sand, brown (10YR 5/3) when moist; single grain; loose; slightly calcareous; pH 9.8; gradual, smooth boundary.
C2--24 to 36 inches, light brownish-gray (10YR 6/2) sand, grayish brown (10YR 5/2) when moist; single grain; loose; slightly calcareous; pH 10.2; gradual, smooth boundary.
C3--36 to 60 inches, pale-brown (10YR 6/3) sand, brown (10YR 5/3) when moist; single grain; loose; slightly calcareous; pH 10.0.

Corlett soils are nearly uniform in the upper 3 feet. Texture is sand or loamy sand, pH values range from 9.0 to more than 10.0, and content of exchangeable sodium ranges from 15 to 75 percent. These soils commonly contain a buried soil or finer textured material in the lower part of the profile that contributes to restricted drainage and very strong alkalinity. The depth to this buried soil or finer textured material depends on the height of the dunes or ridges.

Corlett sand, hilly (CoE).--This soil occupies low dunes and ridges on the valley floor in the central and north-central parts of the survey area. The dunes range from 1/4 acre to 10 acres in size and from 5 to 15 feet in height. The surface layer commonly has a crust of white salt in low-lying areas. This soil has the profile described as representative for the Corlett series. Surface runoff is slow from the dune areas. The hazard of soil blowing is very severe if vegetative cover is not adequate.

Included in mapping, in some low areas between the dunes, are soils that contain mottles and have a seasonal high water table at a depth of 20 to 40 inches.

This soil is used for range and is grazed by cattle and sheep. Capability unit VIIe-3 (nonirrigated); Sand Hummocks range site.

Corlett-Hooper complex, undulating (CpB).--This complex occurs mainly in the central and north-central parts of the county. A small area occurs west of Alamosa near the Rock Creek drainageway. Corlett sand occupies the sand dunes and has the profile described as representative for the Corlett series. These dunes range from 2 feet to 15 feet in height and from a few square yards to 5 or 10 acres in size. The Corlett soil generally is in intricate patterns with the Hooper soils, and mapping them separately was not feasible. Corlett sand represents 30 to 70 percent of this complex. The Hooper soils occupy the low areas between the dunes. These soils include Hooper clay loam and Hooper loamy sand. They make up 30 to 70 percent of the total acreage in the complex. There are many areas of eroded Hooper soils.

Depth to the underlying water table varies largely with the topography. Some of the lake basins have water near the surface, and this generally is the level of the water under the entire complex. The water table commonly is several feet below the tops of dunes and near the surface in the lake basin areas. Surface runoff is slow. The hazard of soil blowing is very severe on the Corlett soil but is only slight to moderate on the Hooper soils.

Included in mapping are areas of Arena loam and Hapney loam that make up as much as 10 percent of the acreage in some places. There also are some inclusions of Space City loamy fine sand. Many of the smaller lake basins are included in this complex.

The vegetation is nearly all greasewood on Hooper clay loam, but some saltgrass, sedges, and alkali sacaton grow in the wetter areas and on Hooper loamy sand. Large areas of the complex are bare. The vegetation on the Corlett soil is greasewood, rabbitbrush, four-wing saltbush, and small amounts of saltgrass and alkali sacaton. The small inclusions of Space City soils have Indian ricegrass, blue grama, and spiny muhly. None of this complex is irrigated, and range is the main use. Capability unit VIIs-5 (nonirrigated); Corlett soil in Sand Hummocks range site; Hooper loamy sand in Salt Flats range site.

Costilla Series

The Costilla series consists of somewhat excessively drained, coarse-textured, nearly level to gently sloping soils on alluvial flood plains. These soils occur mainly in the eastern half of the county.

In a representative profile, the surface layer is dark grayish-brown gravelly loamy sand about 4 inches thick. It is noncalcareous and is mildly alkaline. The next layer is dark-brown loamy sand about 9 inches thick. It is moderately calcareous and strongly alkaline in the lower part. The substratum, to a depth of 60 inches, is brown mainly gravelly loamy sand and gravelly sand that is highly calcareous and strongly alkaline.

Costilla soils have very low available water holding capacity and are very droughty. Permeability is rapid. Plant roots can penetrate to a depth of 60 inches or more.

The vegetation consists of blue grama, ring muhly, little rabbitbrush, and Greens rabbitbrush. These soils are used for range, pasture, and irrigated crops.

Representative profile of Costilla loamy sand, 0 to 2 percent slopes, 1,050 feet west and 1,850 feet south of the northeast corner of sec. 11, T. 36 N., R. 11 E.:

A1--0 to 4 inches, grayish-brown (10YR 5/2) gravelly loamy sand, dark grayish brown (10YR 4/2) when moist; single grain; loose; 15 percent gravel; noncalcareous; pH 7.8; clear, smooth boundary.
AC--4 to 13 inches, brown (10YR 5/3) loamy sand, dark brown (10YR 3/3) when moist; very weak, medium, subangular blocky structure parting to very weak, fine, granular; slightly hard when dry, very friable when moist; pH 8.7; noncalcareous; about 8 percent gravel; clear, smooth boundary.

C1--13 to 19 inches, brown (10YR 5/3) loamy sand, brown (10YR 4/3) when moist; massive; hard when dry, very friable when moist; pH 8.9; moderately calcareous; about 12 percent gravel; clear, smooth boundary.
C2ca--19 to 41 inches, light brownish-gray (10YR 6/2) gravelly loamy sand, brown (10YR 4/3) when moist and (10YR 5/3) when moist and crushed; pH 9.1; highly calcareous; about 25 percent gravel; clear, smooth boundary.
C3ca--41 to 60 inches, pale-brown (10YR 6/3) gravelly sand, brown (10YR 4/3) when moist; massive; very hard when dry, very friable when moist; pH 9.0; highly calcareous; about 20 percent gravel.

The Costilla soils are 10 to 25 percent gravel throughout the profile. Calcium carbonate equivalent of the Cca horizon ranges from 2 to 10 percent.

Costilla loamy sand, 0 to 2 percent slopes (CsA).--This nearly level to gently sloping soil is on alluvial flood plains. Runoff is slow. The hazard of soil blowing is very severe if the vegetative cover is removed.

Included in mapping are small areas of Space City loamy sand and, on the outer edges, small areas of Mosca loamy sand.

The main use for this soil is range, although small areas are irrigated and are used for alfalfa, potatoes, and small grains. This soil is suited to crops if water is available and caution is used in farming. Drought-resistant grasses are suitable for pasture and hay plantings (pl. I, bottom left). Capability units IVe-1 (irrigated) and VIIe-1 (nonirrigated); Sandy Bench range site.

Cotopaxi Series

The Cotopaxi series consists of excessively drained, sandy soils in the northeastern part of the survey area. These soils formed in wind-modified sand that was blown up from the valley floor.

In a representative profile, the surface layer is dark-brown sand, about 8 inches thick, that is noncalcareous and mildly alkaline. The underlying material is dark-brown sand that is noncalcareous and mildly alkaline and extends to a depth of 5 feet or more.

Cotopaxi soils have rapid permeability and very low available water holding capacity. Plant roots can penetrate to a depth of 60 inches or more.

The vegetation consists of Indian ricegrass, blowout grass, and a few plants of little rabbitbrush. Cotopaxi soils are used for range and are grazed by livestock and wildlife.

Representative profile of Cotopaxi sand, hilly, 400 feet north and 0.3 mile west of the southeast corner of sec. 36, T. 40 N., R. 12 E.:

A1--0 to 8 inches, grayish-brown (10YR 5/2) sand, dark brown (10YR 4/3) when moist; single grain; loose; pH 7.8; gradual, wavy boundary.
C--8 to 60 inches, brown (10YR 5/3) sand, dark brown (10YR 4/3) when moist; single grain; loose; pH 7.8.

These soils have very uniform profile characteristics.

Cotopaxi sand, hilly (CtE).--This soil is in the northeastern part of the survey area, close to the dunes of the Great Sand Dunes National Monument. Dominant slopes are 10 to 25 percent. The areas are dunelike and contain dunes as much as 15 feet higher than the depressions. The soil surface is winnowed, and there is an appearance of shifting sand. Screened samples indicate that this soil is 10 percent coarse sand, 40 percent medium sand, 47 percent fine sand, and 3 percent fines. Runoff is very slow. The hazard of soil blowing is very severe if the vegetative cover is not adequate.

The soil is used for range and is grazed by cattle and wildlife. Capability unit VIIe-2 (nonirrigated); Deep Sand range site.

Dune Land

Dune land (Du), a miscellaneous land type, occurs entirely in the northeastern corner of the survey area. The Great Sand Dunes National Munument is largely on this land type (pl. I, bottom right).

The dunes consist of constantly shifting sand and are as much as 600 feet high. Most of the sand is medium sized. This sand has been deposited by wind, presumably by the southwesterly winds that blow across the valley. As the winds rise over the Sangre de Cristo Mountain Range, they lose their velocity and drop the sand. Surface runoff is very slow, permeability is very rapid, and the available water holding capacity is very low. The hazard of soil blowing is very severe.

There is little or no vegetation on the dunes. Some weeds grow in low depressions between some of the dunes. These dunes are used for recreation and sightseeing by local residents and tourists. Capability unit VIIIe-1 (nonirrigated); not in a range site.

Graypoint Series

The Graypoint series consists of somewhat excessively drained soils that formed in moderately coarse textured alluvium underlain by sand and gravel at a depth of 6 to 15 inches. These nearly level soils are on low narrow ridges on flood plains of the valley floor.

In a representative profile, the surface layer is dark-brown or very dark grayish-brown gravelly sandy loam that is noncalcareous and mildly alkaline and is about 2 inches thick. Uncultivated areas have a lighter colored layer 2 inches below the surface. The subsoil is dark-brown mainly sandy clay loam that is noncalcareous and moderately alkaline. It is about 5 to 8 inches thick (pl. II, top left). The substratum consists of gravel and sand

that is highly calcareous and strongly alkaline in the upper 7 inches and is noncalcareous and neutral in the lower part. This extends to a depth of 60 inches or more.

Graypoint soils have a moderately permeable subsoil and a very rapidly permeable substratum. The available water holding capacity is very low.

The vegetation consists of low rabbitbrush and scattered greasewood. These soils are used for irrigated crops, pasture, and range.

Representative profile of Graypoint gravelly sandy loam in an area of Graypoint-Gravelly land complex, 0 to 2 percent slopes, 600 feet south and 450 feet east of the northwest corner of sec. 36, T. 39 N., R. 9 E.:

A1--0 to 2 inches, grayish-brown (10YR 5/2) gravelly sandy loam, very dark grayish brown (10YR 3/2) when moist; weak, medium and fine, granular structure; soft when dry, very friable when moist; 20 percent gravel; noncalcareous; pH 7.5; clear, smooth boundary.

A2--2 to 4 inches, light brownish-gray (10YR 6/2) sandy loam, dark brown (10YR 4/3) when moist; weak, thick, platy structure parting to moderate, fine, granular; slightly hard when dry, very friable when moist; vesicular; noncalcareous; pH 7.0; clear, smooth boundary.

B2t--4 to 9 inches, brown (10YR 5/3) sandy clay loam, dark brown (10YR 3/3) when moist; weak, medium, prismatic structure parting to moderate, fine, subangular blocky; hard when dry, friable when moist; noncalcareous; pH 8.0; very thin patchy clay skins; clear, smooth boundary.

B3ca--9 to 12 inches, light brownish-gray (10YR 6/2) gravelly sandy loam, dark brown (10YR 4/3) when moist; weak, fine, subangular blocky structure; hard when dry, friable when moist; strongly calcareous; pH 8.5; 30 percent gravel; clear, smooth boundary.

IIC1ca--12 to 19 inches, sand and gravel; very strongly calcareous.

IIC2--19 to 60 inches, sand and gravel; noncalcareous.

The A horizon ranges from 4 to 6 inches in thickness and generally includes a light-colored vesicular layer, or A2 horizon, in areas that have not been plowed. In cultivated areas, this A2 horizon is mixed into the plow layer. The A1 horizon has a pH value ranging from 7.4 to 7.8. The B2 horizon ranges from 4 to 10 inches in thickness and has a pH value of 7.9 to 9.0. Depth to gravel ranges from 6 to 15 inches.

Graypoint-Gravelly land complex, 0 to 2 percent slopes (GgA).--This complex occupies low ridges and gravelly areas in the western part of the survey area north of the Rio Grande River. The Graypoint soil has a profile similar to that described as representative for the series. About 50 percent of the complex is Graypoint gravelly sandy loam, and about 50 percent is Gravelly land. In areas where the Graypoint soil has been deep plowed or leveled, the soil profile commonly has been destroyed, and this has left gravel bars exposed in many places. These gravel bars make up most of Gravelly land. In other places deep plowing leaves a gravelly sandy loam surface layer. The soils have very low available water holding capacity and are very droughty. Surface runoff is very slow. The hazard of erosion is slight.

The soils of this complex generally are nearly level. In cultivated fields that have been leveled, slopes are less than 1 percent. In range areas the complex occurs as low ridges that are 1 to 3 feet higher than the surrounding area. These ridges have side slopes of about 2 percent. This complex is used for alfalfa, potatoes, and small grains. Shallow-rooted crops are better adapted than others. The soils are suited to pasture where irrigation water can be applied. Capability units IVs-2 (irrigated) and VIIs-4 (nonirrigated); not in a range site.

Gunbarrel Series

The Gunbarrel series consists of somewhat poorly drained, nearly level, sandy soils that occupy the flood plain on the valley floor. These soils formed in mixed sandy alluvial material and are underlain by sand and fine gravel. They have a high water table and are saline and alkali unless artificially drained.

In a representative profile, the surface layer is dark grayish-brown loamy coarse sand that is noncalcareous and moderately alkaline. It is about 5 inches thick in range areas, is about 10 inches thick in cultivated areas, and has an organic-matter content of less than 1 percent. Below the surface layer, to a depth of 48 inches, is dark grayish-brown loamy coarse sand that is strongly calcareous and strongly alkaline. It is generally gleyed or faintly mottled in the lower part from the high water table. A layer of coarse sand and fine gravel that is noncalcareous occurs at a depth of about 48 inches and extends to a depth of 60 inches and more.

Gunbarrel soils have rapid permeability and low to very low available water holding capacity.

The vegetation consists of alkali sacaton, saltgrass, tall rabbitbrush, and greasewood. These soils are used for irrigated crops, pasture, and range.

Representative profile of Gunbarrel loamy sand, 0.4 mile west and 40 feet south of the northeast corner of sec. 35, T. 40 N., R. 9 E.:

A1--0 to 5 inches, grayish-brown (10YR 5/2) loamy coarse sand, dark grayish-brown (10YR 4/2) when moist; single grain; loose; noncalcareous; pH 8.2; clear, smooth boundary.

AC--5 to 13 inches, brown (10YR 5/3) loamy coarse sand, dark grayish brown (10YR 4/2) when moist; weak, medium, subangular blocky structure; slightly hard when dry, very friable when moist; noncalcareous; pH 8.4; clear, smooth boundary.

C1g--13 to 48 inches, gray (2.5Y 6/1) loamy coarse sand, dark grayish brown (2.5Y 4/2) when moist; few reddish-brown mottles; single

grain; loose; strongly calcareous; pH 8.8; clear, smooth boundary.
IIC2--48 to 60 inches, varicolored coarse sand and fine gravel; noncalcareous.

The main variations are in the amount and distribution of lime in the soil and in the depth to sand and gravel. The depth to calcareous material ranges from 0 to 15 inches. Depth to sand and gravel ranges from 24 to 60 inches. Reaction ranges from 7.9 to 10.0 in pH value.

Gunbarrel loamy sand (0 to 1 percent slopes) (Gn).--This nearly level soil occupies areas of the Rio Grande fan in the northwestern part of the survey area. It has the profile described as representative for the Gunbarrel series. A high water table at a depth of 2 to 4 feet and subirrigation have contributed to the accumulation of exchangeable sodium and soluble salts within the root zone. As the salts are easily leached out with periodic surface irrigations, they generally are not injurious to plant growth. Surface runoff is very slow. The hazard of soil blowing is very severe if the vegetative cover is not adequate.

Included in mapping are small areas of Mosca and McGinty soils.

This soil is suited to most locally adapted crops, and potatoes are extensively grown. Barley and alfalfa also are grown to a large extent. Capability units IVe-1 (irrigated) and VIIe-4 (nonirrigated); Salt Flats range site.

Gunbarrel loamy sand, saline (0 to 1 percent slopes) (Gs).--This nearly level or slightly depressed soil is on the Rio Grande fan in the northwestern part of the survey area. It has a profile similar to that described as representative for the Gunbarrel series, except that it has restricted drainage and a high water table at a depth of 1 to 3 feet. This causes salts to accumulate in the surface layer and makes it moderately to severely saline. Surface runoff is slow. The hazard of soil blowing is severe if the vegetative cover is not adequate.

Included in mapping are small areas of Mosca and San Luis soils.

In its present condition, this soil is better suited to range or pasture than to other uses. Some areas are used for irrigated crops, and most crops adapted to the area can be grown. Large areas of this soil have a plant cover of greasewood, rabbitbrush, saltgrass, and alkali sacaton. Capability units IVew-1 (irrigated) and VIIe-4 (nonirrigated); Salt Flats range site.

Hapney Series

The Hapney series consists of moderately well drained, nearly level soils on flood plains of the valley floor. These soils formed in alluvium and have coarse-textured material at a depth below 40 inches.

In a representative profile, the surface layer is dark grayish-brown loam about 2 inches thick. In cultivated fields the upper layers have been mixed and the plow layer is clay loam about 8 inches thick. It is strongly calcareous and is moderately alkaline to strongly alkaline. The subsoil is very dark gray and very dark grayish-brown clay loam to a depth of 23 inches. It is slightly to moderately calcareous and strongly alkaline. The next 9 inches is dark-gray to black loam. The upper part of the substratum is olive-brown sandy clay loam that is noncalcareous and strongly alkaline. This continues to a depth of about 40 inches. The lower part of the substratum is sand that is moderately alkaline and extends to a depth of 60 inches and more.

Hapney soils have slow permeability and moderate available water holding capacity. The water table is commonly at a depth below 5 feet.

The vegetation is rabbitbrush, greasewood, western wheatgrass, alkali sacaton, blue grama, and saltgrass. These soils are used mainly for range, but some areas are used for irrigated crops and pasture.

Representative profile of Hapney loam, 695 feet west and 75 feet south of the northeast corner of sec. 27, T. 38 N., R. 11 E.:

A2--0 to 2 inches, light-gray (10YR 7/2) loam, dark grayish brown (10YR 4/2) when moist; weak, medium, platy structure parting to weak, fine, granular; hard when dry, friable when moist; strongly calcareous; pH 8.2; clear, abrupt boundary.
B1--2 to 5 inches, dark grayish-brown (10YR 4/2) clay loam, very dark grayish brown (10YR 3/2) when moist; moderate, fine, granular structure; slightly hard when dry, firm when moist; moderately calcareous; pH 8.6; clear, smooth boundary.
B21t--5 to 13 inches, dark-gray (10YR 4/1) heavy clay loam, very dark gray (10YR 3/1) when moist; weak, coarse, prismatic structure and moderate, medium, subangular blocky structure; very hard when dry, very firm when moist; thin nearly continuous clay skins; moderately calcareous; pH 9.0; salt spots; clear, smooth boundary.
B22t--13 to 23 inches, dark-gray (10YR 4/1) heavy clay loam, very dark grayish brown (10YR 3/2) when moist; weak, coarse, prismatic structure and moderate, medium, subangular blocky structure; very hard when dry, very firm when moist; slightly calcareous; pH 9.0; clear, smooth boundary.
B2b--23 to 32 inches, dark-gray (N 4/0) loam, black (N 2/0) when moist; weak, fine, granular structure; slightly hard when dry, friable when moist; noncalcareous; pH 8.6; clear, smooth boundary.
C1--32 to 40 inches, light yellowish-brown (2.5Y 6/4) sandy clay loam, olive brown (2.5Y 4/4) when moist; massive; slightly hard when dry, friable when moist; noncalcareous; pH 8.6; clear, smooth boundary.
IIC2--40 to 60 inches, loose sand; pH 8.2.

The A horizon ranges from fine sandy loam to clay loam. The B2t horizon ranges from sandy clay loam to clay loam or light clay. Depth to the underlying sand ranges from 40 to 60 inches. The pH value ranges from 8.2 to 8.6 in the A horizon and from 8.6 to 10.0 in the B2t horizon. The percentage of exchangeable sodium ranges from 10 to 20 in the upper part of the B horizon and from 15 to 40 in the lower part of the B horizon. Rust-colored mottles occur in the lower part of the profile in some places.

Hapney loam (0 to 1 percent slopes) (Ha).--This level to nearly level soil is on alluvial flood plains. It is mainly in the central part of the survey area, north of the Rio Grande River. Surface runoff is slow. The hazard of soil blowing is slight to moderate in uncultivated areas if the vegetative cover has been removed.

Included in mapping are small areas of Alamosa loam, saline, and of Hooper clay loam.

Much of this soil is used for range (pl. II, top right). Some areas are used for cultivated crops, but the choice of crops is limited because of alkali in the profile. This soil is better suited to small grains than to other crops. It is not suited to potatoes and other vegetable crops. Capability units IVs-1 (irrigated) and VIIs-6 (nonirrigated); Salt Flats range site.

Homelake Series

The Homelake series consists of somewhat poorly drained soils on low flood plains along the Rio Grande River. These soils formed in medium-textured mixed alluvium.

In a representative profile, the surface layer is very dark grayish-brown loam that is noncalcareous and mildly alkaline. It is about 12 inches thick. The upper 18 inches of the substratum is dark-brown loam that contains coarse, distinct, yellowish-brown mottles. It is noncalcareous and is mildly alkaline. The next 10 inches is dark grayish-brown fine sandy loam that contains a few, faint, yellowish-brown mottles. It is noncalcareous and is mildly alkaline. The lower part of the substratum consists of sand and gravel that is noncalcareous and extends to a depth of 60 inches and more.

Homelake soils have moderate permeability and high available water holding capacity. Depth to the water table ranges from 2 to 6 feet and fluctuates with the level of the river. The soils commonly are wet during the irrigation season.

The vegetation consists of rabbitbrush, western wheatgrass, and annual weeds. These soils are used mainly for meadow, but a few areas are used for irrigated crops and pasture.

Representative profile of Homelake loam, 0.1 mile west of the northeast corner of sec. 23, T. 38 N., R. 9 E.:

A11--0 to 6 inches, grayish-brown (10YR 5/2) loam, very dark grayish brown (10YR 3/2) when moist; weak, coarse, subangular blocky structure parting to weak, fine, granular; soft when dry, very friable when moist; noncalcareous; pH 7.5; clear, smooth boundary.

A12--6 to 12 inches, grayish-brown (10YR 5/2) loam, very dark grayish brown (10YR 3/2) when moist; weak, coarse, subangular blocky structure parting to weak, fine, granular; slightly hard when dry, friable when moist; noncalcareous; pH 7.5; clear, smooth boundary.

C1g--12 to 30 inches, grayish-brown (10YR 5/2) loam, dark brown (10YR 4/3) when moist; common, coarse, distinct, yellowish-brown (10YR 5/6) mottles; weak, coarse, subangular blocky structure parting to weak, fine, granular; slightly hard when dry, friable when moist; noncalcareous; pH 7.5; clear, smooth boundary.

C2g--30 to 40 inches, light brownish-gray (10YR 6/2) fine sandy loam, dark grayish brown (10YR 4/2) when moist; few, coarse, faint, yellowish-brown (10YR 5/6) mottles; massive; soft when dry, very friable when moist; noncalcareous; pH 7.5; abrupt, smooth boundary.

IIC3--40 to 60 inches, sand and gravel; noncalcareous.

The A horizon ranges from light clay loam to silt loam, loam, or fine sandy loam. Depth to sand and gravel ranges from 36 to more than 60 inches, and mottles are strong to very faint.

Homelake loam (0 to 1 percent slopes) (Hm).--This soil occupies moderately small areas of low-lying flood plains that border the Rio Grande River. Depth to the water table fluctuates between 2 and 6 feet according to the level of the river, and occasional flooding may occur. The presence of mottles in the soil is evidence that it has been poorly drained in the past, and several layers of deposition are evident through the soil profile. Surface runoff is slow. The hazard of erosion is slight.

Included in mapping are small areas of soils that are shallow over sand and gravel and small areas of associated Alamosa soils.

Most of this soil is used for meadow hay, but small areas are used for alfalfa, small grains, and vegetable crops. All locally adapted crops can be grown. Capability units IIIw-1 (irrigated) and Vw-1 (nonirrigated); Wet meadow range site.

Hooper Series

The Hooper series consists of well-drained, moderately fine textured, nearly level soils on the flood plain of the valley floor. These soils are strongly alkali. They are underlain by sand at a depth of 20 to 40 inches. They are in nearly all parts of the survey area except the sandy areas in the east and the lowlands adjacent to the Rio Grande River. In places the soils occur in basins, are flooded from runoff water, and have a high water table.

In a representative profile, the surface layer is dark grayish-brown loamy sand and sandy loam about 7 inches thick. This layer is strongly calcareous and is very strongly alkaline. The subsoil is brown clay loam and grayish-brown sandy clay loam about 11

inches thick. This layer is moderately calcareous and very strongly alkaline. The upper part of the substratum is grayish-brown sandy loam, about 16 inches thick, that is moderately calcareous and very strongly alkaline. The lower part of the substratum is loose sand beginning at a depth of about 32 inches. It is slightly calcareous and very strongly alkaline and extends to a depth of 60 inches or more (pl. II, bottom left).

Hooper soils have very slow permeability and low available water holding capacity.

Where the surface layer is sandy, the vegetation consists of greasewood, some rabbitbrush, and a small amount of saltgrass and alkali sacaton. Where the surface layer is clay loam, there is only scattered greasewood and no grass. These soils are used for range, irrigated meadow, and wildife habitat.

Representative profile of Hooper loamy sand, 150 feet east and 2,620 feet north of the southwest corner of sec. 31, T. 38 N., R. 9 E.:

A21--0 to 4 inches, light-gray (10YR 7/1) loamy sand, dark grayish brown (10YR 4/2) when moist; weak, thin, platy structure; vesicular; slightly hard when dry, very friable when moist; moderately calcareous; pH 9.4; clear, smooth boundary.

A22--4 to 7 inches, light-gray (10YR 7/1) sandy loam, dark grayish brown (10YR 4/2) when moist; weak, coarse, subangular blocky structure; very hard when dry, very friable when moist; moderately calcareous; pH 9.8; abrupt, wavy boundary.

B2t--7 to 12 inches, light-gray (10YR 7/2) heavy clay loam, brown (10YR 4/3) when moist; slightly lighter and grayer when crushed; moderate, medium, columnar structure and moderate to strong, fine, angular blocky structure; extremely hard when dry, firm when moist; strongly calcareous; pH 10.3; thin continuous clay skins; clear, smooth boundary.

B3--12 to 16 inches, light-gray (10YR 7/1) light sandy clay loam, grayish brown (10YR 5/2) when moist; weak, medium, subangular blocky structure; hard when dry, friable when moist; strongly calcareous; pH 10.4; thin patchy clay skins; clear, smooth boundary.

C1ca--16 to 32 inches, light-gray (10YR 7/1) sandy loam, grayish brown (10YR 5/2) when moist; weak, medium, subangular blocky structure parting to weak, fine, granular; hard when dry, very friable when moist; moderately calcareous, with streaks of lime and gypsum; numerous black mottles that appear to be organic matter or carbon; pH 10.4; gradual, smooth boundary.

IIC2--32 to 60 inches, varicolored loose sand of many sizes; slightly calcareous; pH 10.0.

The A horizon ranges from sand to clay loam in texture. The pH value and the exchangeable sodium percentage in this horizon vary greatly with differences in texture. Where the A horizon is clay loam, the pH value is much higher and the content of exchangeable sodium is higher than where the horizon is sandy. Texture of the B2t horizon ranges from clay loam to clay. Depth to the underlying sand ranges from 20 to 40 inches. The content of exchangeable sodium in the B and C horizons generally ranges from 40 to 90 percent. The B horizon has a pH value of 9.0 to more than 10.0.

Hooper clay loam (0 to 1 percent slopes) (Hp).--This level and nearly level soil occupies flood plains in nearly all parts of the survey area. It has a profile similar to the one described as representative for the Hooper series, except that it has a surface layer of clay loam that is dispersed and very severely restricts the intake of water. Surface runoff is very slow. The hazard of erosion is slight.

Included in mapping are small areas of Hooper loamy sand, Arena loam, and Hapney loam. These soils make up about 10 percent of some areas mapped as Hooper clay loam. Also included are areas that have a water table at a depth of 2 to 4 feet. These areas are moderately saline.

This soil is not suited to cultivated crops, because of the high percentage of exchangeable sodium in the profile. About 90 percent of the soil is slickspots or areas without any vegetation. The pH value in this soil is about 9.5 to 10.5. Greasewood and a small amount of rabbitbrush are the only plants in most places. This soil provides some cover for wildlife. A few small areas that have been kept moist with running water for long periods of time, mainly around artesian wells or where excess canal water has been spread, have a poor stand of sedges, rushes, saltgrass, and alkali sacaton. These plants provide limited grazing, and the areas are good nesting sites for ducks. Capability unit VIIs-4 (nonirrigated); not in a range site.

Hooper loamy sand (0 to 1 percent slopes) (Ho).--This nearly level soil is in nearly all parts of the survey area. It has the profile described as representative for the Hooper series. Surface runoff is very slow. The hazard of soil blowing is moderate if the vegetative cover is not maintained.

Included in mapping are small areas of Hooper clay loam and San Luis sandy loam. Also included are areas that have a water table at a depth of 2 to 4 feet. These areas are moderately saline.

This soil is used mainly for range and is not suited to cultivated crops. The vegetation is greasewood, rabbitbrush, alkali sacaton, and saltgrass. About 20 percent of the surface is bare slickspots where plants do not grow. A few areas are included in irrigated meadows (pl. II, bottom right). Forage production is very limited due to alkali and dispersed soils. Capability units VIs-1 (irrigated) and VIIs-5 (nonirrigated); Salt Flats range site.

Hooper soils, occasionally flooded (0 to 1 percent slopes) (Hs).--These soils are in old, dry lakebeds and in overflowed areas. They are overflowed

infrequently but often enough to prevent alkali sacaton and greasewood from growing. The soils have a profile similar to the one described as representative for the Hooper series, except that the surface layer ranges from sand to clay loam and the water table is at a depth of 2 to 4 feet. These soils are strongly saline, and in many areas white salt has accumulated on the surface. Surface runoff is very slow. The hazard of erosion is slight.

Included in mapping are small areas of Corlett sand and Mosca loamy sand, which make up as much as 15 percent of the acreage mapped as these Hooper soils.

These soils are not suited to cultivated crops. They provide a considerable amount of grazing, however, because of the nearly pure stand of saltgrass. Some scattered greasewood plants grow on the outer edges of the basins. Reseeding the soils is not practical, because of the strong salinity and alkali and the frequency of overflow. Capability unit VIIw-2 (nonirrigated); Alkali Overflow range site.

LaJara Series

The LaJara series consists of poorly drained, nearly level soils on the low flood plains of the valley floor. These soils are in the lower, wetter areas, mainly along LaJara and Alamosa Creeks. They formed in medium-textured to moderately coarse textured, mixed alluvium.

In a representative profile, the surface layer is very dark gray loam, about 10 inches thick, that is moderately calcareous and is neutral. It contains fine yellowish-brown mottles in the lower part. The upper 15 inches of the subsoil is loam with variegated colors of dark yellowish brown and gray. It is moderately calcareous in spots and is moderately alkaline. This grades to the lower part of the subsoil, which is stratified fine sandy loam and loam that is noncalcareous and mildly alkaline. This layer continues to a depth of about 50 inches. The substratum is multicolored loose sand that is noncalcareous and mildly alkaline. It extends to a depth of 60 inches or more.

LaJara soils have moderate permeability above the water table and high available water holding capacity.

The vegetation consists of sedges, rushes, wild iris, and other water-tolerant plants. These soils are used mainly for meadow hay, pasture, and range. Some areas where partial drainage has been established are used for small grains and alfalfa.

Representative profile of LaJara loam, 1,200 feet east and 300 feet north of the southwest corner of sec. 16, T. 36 N., R. 10 E.:

A1--0 to 10 inches, gray (10YR 5/1) loam, very dark gray (10YR 3/1) when moist; moderate, fine, granular structure; slightly hard when dry, friable when moist; moderately calcareous; common, fine, prominent, yellowish-brown (10YR 5/6) mottles; pH 7.0; clear, smooth boundary.

B21g--10 to 25 inches, variegated colors, roughly 50 percent each, yellowish brown (10YR 5/4) and gray (N 5/0) loam, dark yellowish brown (10YR 4/4) and gray (N 5/0) when moist; massive; slightly hard when dry, very friable when moist; moderately calcareous in spots; pH 7.9; gradual, smooth boundary.

B22g--25 to 50 inches, variegated colors, roughly 50 percent each, yellowish brown (10YR 5/4) and gray (N 5/0) stratified very fine sandy loam and loam, dark yellowish brown (10YR 4/4) and gray (N 5/0) when moist; massive; slightly hard when dry, friable when moist; noncalcareous; pH 7.7; clear, smooth boundary.

IIC--50 to 60 inches, multicolored sand; single grain; loose; noncalcareous; pH 7.6.

The A horizon ranges from 5 to 12 inches in thickness and from loam to clay loam in texture. The B2 horizon ranges from 20 to 40 inches in thickness. Its textures include silt loam, loam, very fine sandy loam, and fine sandy loam, and it has an average clay content of less than 18 percent. The pH value throughout the profile ranges from 6.6 to 8.4. Mottles start in the lower part of the dark surface layer. Depth to sand ranges from 40 to more than 60 inches.

LaJara loam (0 to 1 percent slopes) (La).--This nearly level soil occupies moderately extensive areas on low flood plains in the southern part of the survey area. These are low, wet areas along LaJara and Alamosa Creeks where periodic flooding occurs in spring. Because of flooding and the high water table, the soil is strongly mottled and gleyed from the surface downward. The water table ranges from 1 1/2 to 4 feet and is highest in spring and summer. Surface runoff is medium. The hazard of erosion is slight.

Included in mapping are small areas of a soil that is very similar to the LaJara soils, except that the dark surface layer is thin and when it is plowed light-colored material is brought to the surface. This included soil makes up about 30 percent of the acreage mapped as LaJara loam. Also included are small spots in higher areas where salts tend to accumulate. Some small areas of associated Vastine and Nortonville soils also are included.

Most of this soil is used for meadow hay, but some drained areas are used for alfalfa and small grains. This soil is not suited to potatoes and other vegetables. Alfalfa and small grains may be damaged by the high water table, except in areas where drainage can be established. Drainage outlets are difficult to establish. Capability units IVw-1 (irrigated) and Vw-1 (nonirrigated); Wet Meadow range site.

Laney Series

The Laney series consists of well-drained, medium-textured, nearly level alkali soils on flood plains of the valley floor. These soils formed in medium-textured, calcareous alluvial material.

In a representative profile, the surface layer is dark grayish-brown loam, about 4 inches thick, that is highly calcareous and very strongly alkaline. Next is a layer of brown loam that is highly calcareous and very strongly alkaline. It is about 13 inches thick and is underlain by dark grayish-brown or dark-brown loam and sandy loam that is highly calcareous. The substratum, below a depth of about 33 inches, consists of brown and grayish-brown, stratified sand, sandy loam, and clay loam that is noncalcareous, is neutral to mildly alkaline, and continues to a depth of more than 60 inches.

Laney soils have moderate permeability, high available water holding capacity, and a water table that generally is at a depth below 6 feet.

The vegetation consists mainly of big rabbitbrush and lesser amounts of greasewood, wild licorice, sedges, and some alkali sacaton and saltgrass. These soils are mainly used for range, but some areas are used for irrigated crops and pasture.

Representative profile of Laney loam, 1,700 feet south and 500 feet west of the northeast corner of sec. 8, T. 37 N., R. 12 E.:

A1--0 to 4 inches, light brownish-gray (10YR 6/2) loam, dark grayish brown (10YR 4/2) when moist; very weak, fine, granular structure; soft when dry, very friable when moist; highly calcareous; pH 9.4; clear, smooth boundary.

AC--4 to 11 inches, light-gray (10YR 7/2) loam, brown (10YR 5/3) when moist; very weak, medium, subangular blocky structure parting to weak, fine, granular; soft when dry, very friable when moist; highly calcareous; pH 9.9; clear, smooth boundary.

C1--11 to 17 inches, pale-brown (10YR 6/3) loam, brown (10YR 5/3) when moist; weak, medium, subangular blocky structure; slightly hard when dry, very friable when moist; highly calcareous; pH 10.2; clear, smooth boundary.

B2b--17 to 28 inches, light brownish-gray (10YR 6/2) loam, dark grayish brown (10YR 4/2) when moist; moderate, fine, subangular blocky structure parting to moderate to strong, fine, granular; slightly hard when dry, very friable when moist; highly calcareous; pH 8.2; clear, smooth boundary.

B3b--28 to 33 inches, brown (10YR 5/3) sandy loam, dark brown (10YR 4/3) when moist and crushed; weak, medium, subangular blocky structure parting to very weak, fine, granular; hard when dry, very friable when moist; highly calcareous; pH 8.0; clear, smooth boundary.

IIC2--33 to 45 inches, brown (10YR 5/3) sand, brown (10YR 4/3) when moist; massive; slightly hard when dry, very friable when moist; small, fine, faint mottles of yellowish brown (10YR 5/6) when moist; noncalcareous; pH 7.5; clear, smooth boundary.

IIIC3--45 to 60 inches, grayish-brown (10YR 5/2) when moist; stratified sandy loam and clay loam; massive; hard when dry, firm when moist; few salt spots; mottled with yellowish brown (10YR 5/6) when moist; noncalcareous; pH 6.8.

The A horizon ranges from 3 to 6 inches in thickness and has a range in pH value of 8.6 to 9.6. The C horizon consists of stratified loam, clay loam, sandy loam, and sand, and has a pH value ranging from 9.0 to 10.5 in the upper part. Buried horizons and a IIC horizon may be present and have a lower pH value, 7.4 to 8.4. The dark buried soil is not always present. Percentage of exchangeable sodium ranges from 15 to 70. Depth to sand generally is more than 40 inches but ranges from 30 to more than 60 inches.

Laney loam (0 to 1 percent slopes) (Le).--This nearly level soil is on flood plains in the eastern and northeastern parts of the survey area (pl. III, top left). Surface runoff is slow. The hazard of soil blowing is moderate in nonirrigated areas if the vegetative cover is not adequate.

Included in mapping are some areas of sand dunes, generally near the edge of such sandy soils as Corlett or Space City soils. Some small areas of soils that have a sandy surface layer, as well as small slickspots or areas of very strong alkali, also are included.

This soil is used mainly for range, but some areas are in irrigated hay meadows. The soil can be used for cultivated crops if water for irrigation is available. Alfalfa and small grains are grown in some small areas. Most crops common in the survey area can be grown on this soil. Capability units IIIsw-1 (irrigated) and VIIs-3 (nonirrigated); Salt Flats range site.

LaSauses Series

The LaSauses series consists of poorly drained, nearly level, saline-alkali soils on flood plains of the valley floor. These soils formed in medium-textured and fine-textured alluvial material and are mottled and gleyed from wetness.

In a representative profile, the surface layer is dark-brown sandy clay loam that is moderately calcareous and strongly alkaline. It has a white salt crust on the surface and is about 5 inches thick. The next 5 inches is the same color and texture but has only a few small salt spots. The upper part of the subsoil is dark reddish-brown clay loam that is noncalcareous and mildly alkaline and contains many gypsum crystals and other salts. It is strongly mottled with yellow, brown, and gray and is about 7 inches thick. The lower part of the subsoil is heavy clay. It is strongly mottled with red, yellow, and gray. It is medium acid and noncalcareous and contains many gypsum crystals. This layer continues to a depth of 60 inches or more.

LaSauses soils have very slow permeability. Available water holding capacity is moderate, but because of the high amount of salt in the surface layer, moisture is not available to many kinds of plants. Depth to the water table ranges from about 4 feet in dry periods to within a few inches of the surface during the growing season.

The vegetation consists of greasewood, rabbitbrush, saltgrass, and alkali sacaton. These soils are used mainly for range, but some areas where drainage has been provided are used for irrigated crops and pasture.

Representative profile of LaSauses sandy clay loam, 2,400 feet north of the southeast corner of sec. 9, T. 36 N., R. 10 E.:

A1sa1--0 to 5 inches, brown (10YR 5/3) sandy clay loam, dark brown (7.5YR 4/4) when moist; weak, fine, granular structure; slightly hard when dry, friable when moist; moderately calcareous; salt concentrated on the surface in a white crust; pH 8.6; clear, smooth boundary.

A1sa2--5 to 10 inches, brown (10YR 5/3) loam, dark brown (7.5YR 4/4) when moist; very weak, medium, subangular blocky structure parting to weak, fine, granular; hard when dry, firm when moist; moderately calcareous; pH 8.5; few small salt spots; clear, smooth boundary.

B21g--10 to 17 inches, brown (7.5YR 5/4) heavy clay loam, dark reddish brown (5YR 3/3) when moist; weak, medium, granular structure; hard when dry, firm when moist; noncalcareous in matrix with many gypsum crystals and other salts; highly mottled with yellow, brown, and gray; pH 7.5; gradual, smooth boundary.

B22g--17 to 60 inches, mottled red, yellow, and gray heavy clay; moderate, fine, subangular blocky structure; very hard when dry, very firm when moist; many gypsum crystals; noncalcareous; pH 5.9.

The texture of the A horizon ranges from loam to sandy clay loam, and salinity ranges from moderate to strong. Reaction in the A horizon ranges from 7.9 to 9.0 in pH value. Gypsum content in the B horizon ranges from about 2 to 6 percent, and the gypsum is in fine crystals. The pH value is 7.0 to 7.8 in the upper part of the B horizon and is 5.0 to 6.5 in the lower part of the B horizon. Percentage of exchangeable sodium ranges from about 15 to 50 in the A horizon but decreases to about 5 to 10 in the lower part of the B horizon.

LaSauses sandy clay loam (0 to 1 percent slopes) (Ls).--This nearly level soil occupies low flood plains in the southern part of the county along LaJara and Alamosa Creeks. Surface runoff is medium. The hazard of erosion is slight.

This soil is used mainly for range and is suited to this use. Water- and salt-tolerant grasses and legumes are suitable for pasture and hay. This soil is not suited to potatoes or other vegetable crops. Grain and alfalfa are grown to a limited extent. Capability units IVsw-1 (irrigated) and VIw-2 (nonirrigated); Salt Flats range site.

Littlebear Series

The Littlebear series consists of well-drained alkali soils that are mainly moderately coarse textured. These sloping soils are on alluvial fans along the eastern edge of the survey area at foots of mountain slopes. They formed in coarse-textured, stratified alluvial material.

In a representative profile, the upper 4 inches of the surface layer is dark-brown sandy loam that is noncalcareous and very strongly alkaline. The lower 11 inches is very dark grayish-brown sandy loam that is noncalcareous and very strongly alkaline. The next layer is dark-brown sandy loam that is noncalcareous, has more than 15 percent exchangeable sodium, and is about 8 inches thick. This grades into the substratum of dark grayish-brown loamy sand that is moderately calcareous and contains cobblestones and gravel in places. This layer extends to a depth of several feet.

Littlebear soils have moderately rapid permeability in the upper part of the profile and rapid permeability below. The available water holding capacity is moderately low.

The vegetation consists of greasewood, four-wing saltbush, rabbitbrush, snakeweed, blue grama, spiny muhly, and pricklypear. Grazing by livestock and wildlife is the main use of these soils.

Representative profile of Littlebear sandy loam, 3 to 6 percent slopes, 0.4 mile north and 200 feet west of the southeast corner of sec. 1, T. 38 N., R. 12 E.:

A11--0 to 4 inches, brown (10YR 5/3) sandy loam, dark brown (10YR 3/3) when moist; moderate, medium, granular structure; soft when dry, very friable when moist; pH 9.8; noncalcareous; clear, wavy boundary.

A12--4 to 15 inches, grayish-brown (10YR 5/2) sandy loam, very dark grayish brown (10YR 3/2) when moist; weak, coarse, subangular blocky structure parting to moderate, very fine, granular; hard when dry, friable when moist; pH 9.5; clear, smooth boundary.

AC--15 to 23 inches, brown (10YR 5/3) sandy loam, dark brown (10YR 3/3) when moist; weak, fine, granular structure; slightly hard when dry, very friable when moist; pH 7.9; noncalcareous; clear, smooth boundary.

C--23 to 60 inches, light brownish-gray (10YR 6/2) loamy sand, dark grayish brown (10YR 4/2) when moist; single grain; loose; pH 8.2; moderately calcareous; cobbly, with thin stone line at depth of 30 inches.

The A horizon is loamy sand to sandy loam in texture and is 4 to 15 inches thick. In some places mottles occur in the lower part of the profile, indicating that drainage was restricted in the past; in other places there is no mottling. Depth to lime ranges from 10 to 30 inches, and concentration of lime ranges from slight to moderate. Stone lines or cobblestones may occur at any place within the profile or may be absent entirely. Percentage of exchangeable sodium ranges from 10 to 20 in the A horizon and from 10 to 30 in the C horizon.

Littlebear sandy loam, 3 to 6 percent slopes (LtC).--This sloping soil occupies alluvial fans along the base of the Sangre de Cristo Range, on the eastern edge of the survey area. Surface runoff is slow. The hazard of soil blowing is severe if vegetative cover is removed.

Along drainageways there are several active gullies that are 10 to 15 feet wide and about 10 feet deep in places. These are normally dry but may have water in them during spring runoff or summer rains.

This soil is used entirely for range. It is grazed by cattle and sheep, and deer and antelope range over it. This soil provides cover and food for wildlife. Capability unit VIIe-4 (nonirrigated); Valley Sand range site.

Loamy Alluvial Land

Loamy alluvial land (0 to 1 percent slopes) (Lu) is on low flood plains along the Rio Grande River and along Alamosa, LaJara, and Rock Creeks. It consists of nearly level alluvial soils that are more than 20 inches deep over sand. The soils vary widely in color and soil structure. Their texture ranges from loam to clay loam in both the surface layer and underlying material, and in some areas the soil material is highly stratified.

Small areas of Alamosa and Homelake soils are included in mapping.

Salt accumulations range from none to slight. The water table occasionally may rise to within 20 to 36 inches of the surface during the growing season but commonly is 4 to 5 feet below the surface in drier periods. Permeability is moderate to moderately slow. Surface runoff is slow. The hazard of erosion is slight. The available water holding capacity is moderate to high.

The vegetation consists mainly of alkali sacaton, saltgrass, and sedges, but there is some rabbitbrush and greasewood. This land type is used for range and for irrigated crops. Alfalfa and small grains are suitable. In some places vegetable crops are grown. Salt- and water-tolerant grasses and legumes are suitable for pasture and hay. Capability units IIIw-1 (irrigated) and Vw-1 (nonirrigated); Wet Meadow range site.

Marsh

Marsh (Ma) consists of permanently wet swamps and marshes in low, undrained areas along the major rivers and creeks in the southern part of the survey area.

The soils range from sandy to clayey in texture. Water stands on these areas much of the time, and it is within a few inches of the surface the rest of the time. Because these areas are low, they have no drainage outlets.

The vegetation is cattails, sedges, and rushes. These areas have no grazing value except around the edges during the driest part of the year. This land type provides good nesting and cover for ducks and good duck hunting areas. Capability unit VIIIw-1 (nonirrigated); not in a range site.

McGinty Series

The McGinty series consists of well-drained, moderately coarse textured, nearly level soils on flood plains of the valley floor. In places these soils are seeped by irrigation water and have a high water table. They formed in moderately coarse textured, mixed alluvium.

In a representative profile, the surface layer is dark-brown sandy loam that is slightly calcareous, moderately alkaline, and about 6 inches thick. The next layer is dark-brown sandy loam that is slightly calcareous, moderately alkaline, and about 13 inches thick. The upper 10 inches of the substratum is dark grayish-brown sandy loam that is highly calcareous and moderately alkaline. The lower part of the substratum is pale-brown sandy loam that is highly calcareous and moderately alkaline. This part is about 30 inches thick and is over sand and fine gravel in some areas and over loamy material in other areas.

McGinty soils have moderately rapid permeability and moderate available water holding capacity. The water table generally is below a depth of 5 feet, but in areas that have been seeped from irrigation the water table is at a depth of 2 to 4 feet.

The vegetation consists of greasewood, rabbitbrush, saltgrass, and alkali sacaton. These soils are used for irrigated crops, pasture, and range.

Representative profile of McGinty sandy loam, 100 feet east and 2,540 feet north of the southwest corner of sec. 1, T. 40 N., R. 9 E.:

Ap--0 to 6 inches, brown (10YR 5/3) sandy loam, dark brown (10YR 3/3) when moist; weak, fine, granular structure; slightly hard when dry, friable when moist; slightly calcareous; pH 8.0; clear, smooth boundary.

AC--6 to 19 inches, pale-brown (10YR 6/3) sandy loam, dark brown (10YR 3/3) when moist; very weak, coarse, subangular blocky structure; slightly hard when dry, very friable when moist; some small gravel; slightly calcareous; pH 8.2; gradual, smooth boundary.

C1--19 to 30 inches, light brownish-gray (10YR 6/2) sandy loam, dark grayish brown (10YR 4/2) when moist; massive; slightly hard when dry, friable when moist; some small gravel; highly calcareous, with lime occurring as spots and streaks; pH 8.4; clear, smooth boundary.

C2ca--30 to 60 inches, white (10YR 8/2) sandy loam, pale brown (10YR 6/3) when moist; massive; slightly hard when dry, very friable when moist; highly calcareous; pH 8.2; grades into sand in the lower part.

The A1 horizon ranges from 7.9 to 8.4 in pH value and from about 5 to 10 inches in thickness. Depth to the zone of lime accumulation ranges from 20 to 40 inches, and this zone (C2ca horizon) contains from 15 to 35 percent calcium carbonates. The C horizon ranges from 7.4 to 8.4 in pH value. Depth to the sand substratum generally is more than 40 inches. In some areas the substratum is loam in texture below a depth of 30 inches.

McGinty sandy loam (0 to 1 percent slopes) (Mc).--This soil occurs on low ridges on the lower end of the Rio Grande fan in the vicinity of Mosca and Hooper and on narrow ridges in the southwestern part of the survey area. It has the profile described as representative for the McGinty series. Surface runoff is slow. The hazard of soil blowing is slight to moderate if the vegetation has been removed. The water table commonly is at a depth below 5 feet.

Included in mapping are small areas of soils that have slight salt accumulations in the surface layer. Also included are small areas of Gunbarrel loamy sand and Mosca loamy sand.

This soil is used extensively for irrigated crops. Potatoes, barley, oats, and alfalfa are the main crops. All locally adapted crops do well on this soil if it is irrigated. Some small areas are used for range for cattle and sheep grazing. Capability units IIIs-3 (irrigated) and VIIs-3 (nonirrigated); Salt Flats range site.

McGinty sandy loam, saline (0 to 1 percent slopes) (Mg).--This soil occupies low areas along low ridges, chiefly in the southwestern part of the Alamosa Area. It has a profile similar to the one described as representative for the McGinty series, except that it is slightly to moderately saline and has a high water table at a depth of 2 to 4 feet, resulting from seepage. In uncultivated areas a crust of white salt forms on the surface and saltgrass is more abundant. In cultivated areas there are spots with poor stands and some salts showing on the surface. Surface runoff is slow. The hazard of erosion is slight.

Included in mapping are small areas of Gunbarrel loamy sand and Mosca loamy sand.

This soil is used for irrigated crops. Potatoes, barley, oats, and alfalfa are the main crops grown. Some areas are used for range for cattle and sheep grazing. Capability units IIIsw-3 (irrigated) and VIw-2 (nonirrigated) Salt Flats range site.

Medano Series

The Medano series consists of somewhat poorly drained soils that formed in stratified, weakly calcareous alluvium over sand.

In a representative profile, the surface is covered with an organic mat about 3 inches thick. Beneath this is a surface layer of black fine sandy loam and sandy loam. This layer is about 12 inches thick, is moderately calcareous, is high in organic-matter content, and is moderately alkaline to mildly alkaline. The next layer is very dark brown loamy sand that is noncalcareous, mildly alkaline, and about 6 inches thick. The upper part of the substratum is brown loamy sand that is noncalcareous and mildly alkaline. This grades to black sand at a depth of about 45 inches.

The Medano soils have moderately rapid permeability in the surface layer and rapid permeability below. The available water holding capacity is low; however, water normally is available to plants because the lower part of the root zone is kept moist by the water table. The water table commonly is at a depth of about 30 inches but ranges from a depth of 1 foot in spring to a depth of about 40 inches in the driest part of the year.

The vegetation is sedges, rushes, and water-tolerant grasses. These soils are used chiefly for meadow, but small areas are used for irrigated crops. Some areas are used for range.

Representative profile of Medano fine sandy loam, 1,600 feet south and 1,900 feet east of the northwest corner of sec. 17, T. 40 N., R. 12 E.:

O1--3 inches to 0, organic material consisting mostly of decomposed grass, leaves, and roots.

A11--0 to 5 inches, gray (10YR 5/1) fine sandy loam, black (10YR 2/1) when moist; weak, medium, subangular blocky structure parting to moderate, medium, granular; slightly hard when dry, very friable when moist; moderately calcareous; pH 8.0; clear, smooth boundary.

A12--5 to 12 inches, gray (10YR 5/1) sandy loam, black (10YR 2/1) when moist; weak, medium, subangular blocky structure parting to moderate, medium, granular; slightly hard when dry, friable when moist; moderately calcareous; pH 7.8; clear, smooth boundary.

AC--12 to 18 inches, gray (10YR 5/1) loamy sand, very dark brown (10YR 2/2) when moist; single grain; loose; noncalcareous; pH 7.6; abrupt, wavy boundary.

C1g--18 to 45 inches, light brownish-gray (10YR 6/2) loamy sand, brown (10YR 4/3) when moist; single grain; loose when dry, very friable when moist; noncalcareous; pH 7.6; abrupt, wavy boundary.

IIC2--45 to 60 inches, olive-gray (5Y 4/2) sand, black (5Y 2/2) when moist; single grain; loose; noncalcareous; upper part of this horizon is hard and brittle; pH 7.6.

The organic mat ranges from 2 to 5 inches in thickness. Thickness of the A horizon ranges from 10 to 20 inches. Depth to sand ranges from 30 to 50 inches. The A horizon has a pH value of 7.4 to 8.4.

Medano fine sandy loam (0 to 1 percent slopes) (Mn).--This soil is in the northeastern part of the survey area in drainageways of Sand and Spring Creeks. Surface runoff is slow. The hazard of erosion is slight.

Included in mapping is a small acreage of Laney loam and small areas of Gunbarrel loamy sand.

This soil is used mainly for irrigated meadow. Small areas are used for alfalfa and small grains. The soil is suitable for alfalfa, potatoes, barley, oats, and clover. Some areas are used for range and are grazed by cattle. Capability units IVw-1 (irrigated) and Vw-1 (nonirrigated); Wet Meadow range site.

Mosca Series

The Mosca series consists of well-drained alkali soils that have a moderately coarse textured subsoil. These soils are on alluvial flood plains on the valley floor. They formed in calcareous, moderately coarse textured alluvial material and are underlain by sand and fine gravel. In places the soils are seeped by irrigation water and have a high water table.

In a representative profile, the surface layer in undisturbed areas is dark grayish-brown loamy sand that is noncalcareous, strongly alkaline, and about 3 inches thick. Under this is a 2-inch layer of dark-brown loamy sand that is noncalcareous and has a high concentration of sodium. In cultivated areas, the upper layers are mixed and the plow layer is dark grayish-brown loamy sand about 8 inches thick. The subsoil is dark-brown and dark grayish-brown sandy loam that is moderately calcareous, very strongly alkaline, and about 12 inches thick. The content of exchangeable sodium is more than 25 percent and decreases with depth. The substratum, to a depth of 36 inches, is grayish-brown sandy loam and loamy sand that is moderately calcareous. It has an exchangeable sodium content of more than 25 percent and is very strongly alkaline. Between depths of 36 and 60 inches is noncalcareous, clean sand and gravel.

Mosca soils have low available water holding capacity and moderately rapid permeability.

The vegetation is greasewood, rabbitbrush, fourwind saltbush, blue grama, Indian ricegrass, spiny muhly, and, in the seeped areas, saltgrass and alkali sacaton. These soils are used for irrigated crops, pasture, and range.

Representative profile of Mosca loamy sand, 125 feet south and 1,320 feet east of the center of sec. 34, T. 40 N., R. 9 E.:

A1--0 to 3 inches, light brownish-gray (10YR 6/2) loamy sand, dark grayish brown (10YR 4/2) when moist; single grain; loose; noncalcareous; pH 8.6; abrupt, smooth boundary.

A2--3 to 5 inches, light-gray (10YR 7/2) loamy sand, dark brown (7.5YR 4/2) when moist; weak, thin, platy structure parting to moderate, fine, granular; soft when dry, very friable when moist; noncalcareous; pH 10.0; clear, smooth boundary.

B2t--5 to 10 inches, pale-brown (10YR 6/3) sandy loam, dark brown (10YR 4/3) when moist; weak to moderate, medium, prismatic structure parting to moderate, medium, subangular blocky; hard when dry, very friable when moist; moderately calcareous; pH 9.6; thin patchy clay skins on sand grains and ped faces; clear, smooth boundary.

B3--10 to 17 inches, light brownish-gray (10YR 6/2) sandy loam, dark grayish brown (10YR 4/2) when moist; weak, medium, subangular blocky structure; slightly hard when dry, very friable when moist; moderately calcareous; pH 9.0; clear, smooth boundary.

C1ca--17 to 26 inches, light-gray (10YR 7/2) sandy loam, grayish brown (10YR 5/2) when moist; very weak, medium, subangular blocky structure; hard when dry, very friable when moist; moderately calcareous; pH 9.2; clear, smooth boundary.

C2--26 to 36 inches, light-gray (10YR 7/2) loamy sand, grayish brown (10YR 5/2) when moist; massive; hard when dry, very friable when moist; moderately calcareous; pH 8.6; clear, smooth boundary.

IIC3--36 to 60 inches, sand and gravel; single grain; loose; noncalcareous.

The A horizon ranges from 4 to about 10 inches in thickness. The A2 horizon, or thin gray layer, commonly is absent in cultivated fields because of plowing and mixing of the upper layers. Texture is loamy sand or light sandy loam. Clay content in the B horizon ranges from 10 to 18 percent, and thickness ranges from 8 to 14 inches. Exchangeable sodium content of the B horizon and the upper C horizon ranges from 15 to 30 percent. The pH value is 8.5 to 10.0. Gravel content of the soil may range up to 10 percent, but normally is less than 5 percent. Depth to sand and gravel ranges from 20 to more than 36 inches.

Mosca loamy sand (0 to 1 percent slopes) (Mo).--This well-drained, nearly level soil occupies areas on the Rio Grande fan in the northwestern part of the Alamosa Area and on flood plains in the east-central part of the Area. It has the profile described as representative for the Mosca series. Slight accumulations of salt are common in places, and alkali is moderate to strong in the subsoil and decreases with depth. The water table normally is at a depth below 5 feet except when raised periodically for subirrigation. Surface runoff is slow. The hazard of soil blowing is very severe in nonirrigated areas if the vegetative cover is not maintained.

Included in mapping are small areas of Gunbarrel, San Luis, and McGinty soils, which make up about 20 percent of the total acreage.

This soil is used for all locally adapted irrigated crops and pasture. Much of it is used for range that has a cover of rabbitbrush, greasewood, blue grama, Indian ricegrass, and alkali sacaton. Capability units IIIe-2 (irrigated) and VIIe-4 (nonirrigated); Valley Sand range site.

Mosca loamy sand, wet (0 to 1 percent slopes) (Ms).--This soil occupies low, flat areas north and east of the Rio Grande River. It is somewhat poorly drained and normally has a high water table at a depth of 2 to 4 feet during most of the year. It has moderate accumulations of soluble salts in the surface layer or subsoil that restrict crop growth. Surface runoff is slow. The hazard of soil blowing is moderate if the vegetative cover is not adequate.

Included in mapping are small areas of Gunbarrel soils and some areas of Mosca loamy sand.

This soil is used for irrigated crops, pasture, and range. Crops include potatoes, small grains, and alfalfa. The vegetation in range areas is greasewood, rabbitbrush, saltgrass, and alkali sacaton. Capability units IIIew-2 (irrigated) and VIw-2 (nonirrigated); Salt Flats range site.

Mount Home Series

The Mount Home series consists of very cobbly, moderately coarse textured, somewhat excessively drained, sloping soils that formed in alluvial material on the fans at the foot of the Sangre de Cristo Mountain Range. These soils are droughty but are in an area that receives more rainfall than other parts of the survey area.

In a representative profile, the surface layer is very dark grayish-brown very cobbly sandy loam and very cobbly fine sandy loam about 17 inches thick. It is moderately alkaline and is about 65 percent cobblestones, stones, and gravel. The upper 5 inches is noncalcareous, and the lower part is slightly calcareous. The substratum, to a depth of 60 inches, is brown very cobbly sandy loam that is highly calcareous, is moderately alkaline, and is about 85 percent cobblestones, stones, and gravel. The amount of lime decreases in the lower part of the substratum.

Mount Home soils have moderately rapid permeability. Some streams that originate in the mountains disappear into this very cobbly soil. The available water holding capacity is very low.

Mount Home soils are used for range that provides grazing for livestock and food for wildlife. In the Alamosa Area, these soils were mapped only in a complex with the Sagauche soils.

Representative profile of Mount Home very cobbly sandy loam, in an area of Mount Home-Sagauche cobbly sandy loams, 4 to 12 percent slopes, 1,500 feet east and 1,200 feet south of the northwest corner of sec. 31, T. 28 S., R. 73 W.:

A11--0 to 5 inches, light brownish-gray (10YR 6/2) very cobbly sandy loam, very dark grayish brown (10YR 3/2) when moist; weak, fine, granular structure; soft when dry, very friable when moist; noncalcareous; pH 8.0; approximately 65 percent cobblestones, stones, and gravel; clear, smooth boundary.

A12--5 to 17 inches, light brownish-gray (10YR 6/2) very cobbly fine sandy loam, very dark grayish brown (10YR 3/2) when moist; weak, fine, granular structure; soft when dry, very friable when moist; slightly calcareous; pH 8.0; approximately 65 percent cobblestones, stones, and gravel; clear, smooth boundary.

C1ca--17 to 37 inches, very pale brown (10YR 7/3) very cobbly sandy loam, brown (10YR 5/3) when moist; massive; soft when dry, very friable when moist; highly calcareous, with visible disseminated lime and lime coatings on lower side of cobblestones; pH 8.2; approximately 85 percent cobblestones, stones, and gravel; gradual, smooth boundary.

C2ca--37 to 60 inches, pale-brown (10YR 6/3) very cobbly sandy loam, brown (10YR 5/3) when moist; massive; soft when dry, very friable when moist; highly calcareous in upper part, with lime decreasing with depth; pH 8.2; approximately 85 percent cobblestones, stones, and gravel.

The main variations in this soil are in the amount of cobblestones, stones, and gravel, which may range from 50 to 90 percent throughout the profile. The amount of cobblestones and stones normally increases with depth. The texture ranges from very cobbly fine sandy loam to very cobbly loamy fine sand. Reaction of the A horizon ranges from pH values of 7.4 to 8.4. The C horizon ranges from pH values of 7.9 to 8.4.

Mount Home-Sagauche cobbly sandy loams, 4 to 12 percent slopes (MtD).--This complex consists of sloping Mount Home and Sagauche soils. It is only on the fan from the mountains along the eastern edge of the survey area. There are numerous small gullies from 2 to 5 feet deep where water runs briefly during hard rainfall in the higher areas. About 65 percent of the complex is Mount Home very cobbly sandy loam (pl. III, top right), and about 35 percent is Sagauche sandy loam. The available water holding capacity of these soils is very low. Surface runoff is slow. The hazard of erosion is slight to moderate.

The vegetation consists of Indian ricegrass, blue grama, mountain muhly, Apache-plume, and little rabbitbrush. There are a few scattered pinyon trees along the higher edge of the mapping unit where it borders areas of Uracca soils. Two areas of the unit that are drainageways and have some underground streamflow have ponderosa pine and aspen trees and an understory of brush.

The soils of this complex are used exclusively for grazing. They are too cobbly for cultivation. This complex provides a habitat for antelope and deer. Capability unit VIIs-1 (nonirrigated); Foothill Sand range site.

Nortonville Series

The Nortonville series consists of medium-textured, somewhat poorly drained, nearly level, saline-alkali soils on low flood plains of the valley floor. These soils formed in weakly stratified, medium-textured to moderately fine textured alluvium.

In a representative profile, the surface layer is very dark brown loam about 5 inches thick. It is calcareous and strongly alkaline and contains some salt spots. The next 4 inches is similar, except that it is very dark grayish brown light clay loam. This layer contains gypsum as well as salt spots. The upper 20 inches of the substratum is dark grayish-brown and dark-brown clay loam and loam. It is moderately calcareous and strongly alkaline. Below this, to a depth of 60 inches or more, the substratum consists of dark-brown layers of loam and fine sandy

loam. These layers are noncalcareous and moderately alkaline and contain many, fine, yellowish-brown mottles.

Nortonville soils have moderately slow permeability and high available water holding capacity. The water table is within a depth of 2 feet during the growing season and is generally at a depth of about 3 to 4 feet during winter.

The vegetation consists of a dense stand of alkali sacaton and saltgrass, and there are small amounts of greasewood and rabbitbrush. These soils are used mainly for irrigated pasture. Some areas are used for irrigated crops or for range.

Representative profile of Nortonville loam, 1,300 feet south and 600 feet east of the center of sec. 7, T. 36 N., R. 11 E.:

A1cs--0 to 5 inches, grayish-brown (10YR 5/2) loam, very dark brown (10YR 2/2) when moist; weak, medium, subangular blocky structure parting to weak, fine, granular; hard when dry, firm when moist; moderately calcareous; some salt spots; pH 8.5; abrupt, wavy boundary.

ACcs--5 to 9 inches, grayish-brown (10YR 5/2) light clay loam, very dark grayish brown (10YR 3/2) when moist; weak, fine, granular structure; slightly hard when dry, friable when moist; moderately calcareous; some salt spots and gypsum; pH 8.5; clear, smooth boundary.

C1cs--9 to 14 inches, light brownish-gray (10YR 6/2) light clay loam, dark grayish brown (10YR 4/2) when moist; weak, coarse, subangular blocky structure and weak, fine, granular; slightly hard when dry, friable when moist; moderately calcareous; large amount of gypsum crystals; pH 8.4; clear, smooth boundary.

C2g--14 to 29 inches, grayish-brown (10YR 5/2) loam, dark brown (10YR 4/3) when moist; weak, coarse, prismatic structure parting to weak, medium, subangular blocky; slightly hard when dry, very friable when moist; moderately calcareous; numerous lime spots; common, fine, distinct, yellowish-brown mottles; pH 8.2; clear, smooth boundary.

C3--29 to 60 inches, pale-brown (10YR 6/3) loam and fine sandy loam, dark brown (10YR 4/3) when moist; massive; slightly hard when dry, friable when moist; noncalcareous; many, fine, distinct, yellowish-brown mottles; pH 8.0.

The A horizon ranges from about 5 to 24 inches in thickness. The cs horizons range from 10 to 40 percent in content of gypsum. Salinity ranges from moderate to strong. The A horizon is moderately alkaline to strongly alkaline in reaction and has a pH value of 7.9 to 9.0. The C horizon ranges from fine sandy loam to clay loam in texture and from 7.9 to 8.4 in pH value. Content of exchangeable sodium ranges from 15 to 40 percent in the upper part of the C horizon but decreases in the lower part of the C horizon.

Nortonville loam (0 to 1 percent slopes) (No).--This soil is on low flood plains along LaJara and Alamosa Creeks and the Rio Grande River in the southern part of the survey area. It has a thin crust of salt on the surface in many places. In irrigated meadows there is a thin mat of organic material on the surface. Surface runoff is slow. The hazard of erosion is slight.

Included in mapping are small areas of Vastine and Homelake soils. These areas make up no more than 5 percent of the mapping unit.

This soil is used mainly for pasture and irrigated meadow (pl. III, bottom). Some alfalfa and small grains are grown. The soil is not suited to potatoes and vegetables. In areas where drainage outlets are available and drainage and leaching have been accomplished, small grains and alfalfa can be grown. Capability units IIIw-2 (irrigated) and VIw-1 (nonirrigated); Salt Meadow range site.

Peat

Peat (Pe), a miscellaneous land type, is in an old creek channel that has lost its main source of water. The stream apparently found a new course to the river as the landscape was gradually lowered. There is subsurface water in this old channel.

The peat is 2 to 8 feet deep and is underlain by sand. In some places there is a layer of lime 3 to 12 inches thick on the surface. The peat is medium acid to strongly acid. It is normally moist in the upper 2 to 3 feet. The underlying sand is wet and mottled. The water table is in the sand substratum.

The vegetation is mostly sedges and rushes. This land type is used for grazing. In the past, when more water was available, it was used for irrigated hayland. Capability unit Vw-1 (nonirrigated); not in a range site.

Saguache Series

The Saguache series consists of mainly moderately coarse textured soils that are underlain by gravel and sand at a depth of 8 to 15 inches. These soils formed in alluvium on fans and flood plains. They are excessively drained and are very droughty.

In a representative profile, the surface layer is very dark grayish-brown sandy loam and fine sandy loam that is noncalcareous and strongly alkaline. This is underlain by gravel and sand at a depth of about 10 inches. In many places the surface layer is gravelly or cobbly.

Saguache soils absorb water rapidly and have very rapid permeability. Some streams that originate in the mountains disappear into these soils. The available water holding capacity is very low.

The Saguache soils are used for range that provides grazing for livestock and food for wildlife. In the Alamosa Area, these soils occur only in a complex with the Mount Home soils. For a description of that complex, see the Mount Home series.

Representative profile of Saguache sandy loam, in an area of Mount Home-Saguache cobbly sandy loams, 4 to 12 percent slopes, 1,800 feet north and 0.5 mile east of the southwest corner of sec. 7, T. 29 S., R. 73 W.:

A11--0 to 4 inches, grayish-brown (10YR 5/2) sandy loam, very dark grayish brown (10YR 3/2) when moist; weak, thin, platy structure parting to weak, fine, granular; slightly hard when dry, friable when moist; noncalcareous; pH 9.0; clear, smooth boundary.

A12--4 to 10 inches, grayish-brown (10YR 5/2) fine sandy loam, very dark grayish brown (10YR 3/2) when moist; weak, medium, subangular blocky structure parting to weak, fine, granular; slightly hard when dry, friable when moist; noncalcareous; pH 8.5; clear, smooth boundary.

IIC--10 to 60 inches, cobblestones, gravel, and sand; noncalcareous; pH 8.5.

The texture of the A horizon ranges from sandy loam to loam, and the horizon is 5 to 25 percent cobblestones. Depth to cobblestones, gravel, and sand ranges from 8 to 15 inches.

San Arcacio Series

The San Arcacio series consists of moderately well drained soils on flat alluvial flood plains in the southwestern part of the county. These soils formed in mixed calcareous alluvium and are underlain by gravel and sand at a depth of 20 to 36 inches. In places they are seeped by irrigation water and have a high water table.

In a representative profile, the surface layer is dark-brown sandy loam about 9 inches thick. It is noncalcareous and moderately alkaline. The subsoil is dark-brown sandy clay loam about 5 inches thick. It is noncalcareous and moderately alkaline. The upper 4 inches of the substratum is pale-brown sandy clay loam that is highly calcareous and strongly alkaline. The next 6 inches is dark grayish-brown loamy sand that is calcareous and strongly alkaline. Below this is noncalcareous sand and gravel that extends to a depth of 60 inches or more.

San Arcacio soils have moderate permeability and low available water holding capacity.

The vegetation consists of greasewood, rabbitbrush, saltgrass, and alkali sacaton. These soils are used for irrigated crops, pasture, and range.

Representative profile of San Arcacio sandy loam, 950 feet north and 110 feet east of the southwest corner of sec. 25, T. 37 N., R. 9 E.:

Ap--0 to 9 inches, brown (10YR 5/3) sandy loam, dark brown (10YR 3/3) when moist; weak, medium, subangular blocky structure parting to moderate, fine, granular; slightly hard when dry, very friable when moist; noncalcareous; pH 8.1; clear, smooth boundary.

B2t--9 to 14 inches, brown (10YR 5/3) sandy clay loam, dark brown (10YR 3/3) when moist; weak to moderate, medium, subangular blocky structure; slightly hard when dry, friable when moist; thin nearly continuous clay skins; noncalcareous; pH 8.4; clear, smooth boundary.

C1ca--14 to 17 inches, light brownish-gray (10YR 6/2) sandy clay loam, pale brown (10YR 6/3) when moist; weak, coarse, subangular blocky structure; hard when dry, friable when moist; highly calcareous; pH 8.5; abrupt, smooth boundary.

C2--17 to 23 inches, grayish-brown (10YR 5/2) loamy sand, dark grayish brown (10YR 4/2) when moist; single grain; loose; calcareous; pH 8.6; gradual, smooth boundary.

IIC3--23 to 60 inches, noncalcareous gravel and sand.

The A horizon ranges from 4 to 10 inches in thickness and from sandy loam to light sandy clay loam in texture. Reaction of the A horizon ranges from 7.9 to 8.4 in pH value. The B2 horizon ranges from 4 to 8 inches in thickness and is sandy clay loam, heavy sandy loam, or light clay loam. The pH value of the B horizon ranges from 7.4 to 8.4. The layer of lime accumulation is 3 to 8 inches thick. Depth to gravel ranges from 20 to 36 inches and averages about 22 inches. Gravel content ranges from 5 to 15 percent in the solum and from 60 to 80 percent in the substratum.

San Arcacio sandy loam (0 to 1 percent slopes) (Sa).--This moderately well drained soil occupies low, flat alluvial flood plains in the southwestern part of Alamosa Area. It has the profile described as representative for the San Arcacio series. Depth to the water table normally is 3 to 4 feet during most of the year. Surface runoff is slow. The hazard of soil blowing in nonirrigated areas is slight to moderate if the vegetative cover is removed.

Included in mapping are small areas of San Arcacio sandy loam, saline, which make up about 15 percent of the acreage, and small areas of Villa Grove sandy clay loam or Zinzer loam, which make up as much as 5 percent.

This soil is suited to all adapted crops and is used extensively for vegetable crops. Alfalfa, potatoes, small grains, and pasture are grown on this soil. Some areas are used for range. Capability units IIIs-2 (irrigated) and VIIs-3 (nonirrigated); Salt Flats range site.

San Arcacio sandy loam, saline (0 to 1 percent slopes) (Sc).--This soil occupies low, slightly depressed areas on an alluvial flood plain. It has a profile similar to that described as representative for the San Arcacio series, except that it is poorly drained and contains moderate to strong accumulations of soluble salts. The water table fluctuates to within 15 inches of the surface during the growing season. During fall and winter, the water table may be as much as 3 feet below the surface. Surface runoff is slow. The hazard of erosion is slight.

Included in mapping are small areas of Villa Grove sandy clay loam and Zinzer loam.

All crops adapted to the area are grown on this soil. Only salt- and water-tolerant grasses are suitable for pasture seeding. The soil also is used for range. Capability units IIIsw-2 (irrigated) and VIw-2 (nonirrigated); Salt Flats range site.

Sandy Alluvial Land

Sandy alluvial land (0 to 1 percent slopes) (Sd) is in old oxbows and intermittent channels along the low bottoms of the Rio Grande River.

This land type consists of medium-textured and coarse-textured soils that generally are underlain by sand and gravel at a depth of 8 to 20 inches. About 20 percent is made up of deeper soils in old channels that have filled in, and about 10 percent is gravel bars.

The soils of this land type are droughty. They are excessively drained most of the time, but they may be flooded or the water table may be 2 or 3 feet from the surface when the river is high. The soils are not saline and are essentially lime free. Permeability ranges from moderately rapid to very rapid. The available water holding capacity is very low.

The vegetation is narrowleaf cottonwood and willows and an understory of grasses and sedges. Most of this land type is used for livestock grazing and wildlife habitat. Small areas are included in irrigated hay meadows. This land type is a good source of sand and gravel. Capability units IVs-2 (irrigated) and VIIw-1 (nonirrigated); not in a range site.

San Luis Series

The San Luis series consists of somewhat poorly drained or poorly drained, nearly level, strongly alkali soils on flood plains of the valley floor in the western and northwestern parts of the survey area. These soils formed in moderately fine textured, mixed alluvium underlain by sand at a depth of 24 to 40 inches.

In a representative profile, the surface layer is dark-brown sandy loam that is slightly calcareous, moderately alkaline, and about 7 inches thick. The subsoil is dark-brown and brown sandy clay loam and dark grayish-brown clay loam that is weakly calcareous in the upper part and grades to highly calcareous in the lower part. This layer is very strongly alkaline and about 9 inches thick. The substratum, to a depth of 34 inches, is gray clay loam and sandy clay loam that is highly calcareous, is very strongly alkaline, and has an exchangeable sodium content of 30 percent or more. This material grades to mottled sand that is very high in content of sodium and extends to a depth of 60 inches or more.

San Luis soils have high available water holding capacity and moderately slow permeability.

The vegetation is greasewood, rabbitbrush, saltgrass, and alkali sacaton. These soils are used for irrigated crops, pasture, and range.

Representative profile of San Luis sandy loam, drained, 1,000 feet west and 2,590 feet south of the northeast corner of sec. 13, T. 39 N., R. 10 E.:

Ap--0 to 7 inches, grayish-brown (10YR 5/2) sandy loam, dark brown (10YR 3/3) when moist; weak, thick, platy structure parting to moderate, very fine, granular; soft when dry, very friable when moist; slightly calcareous; pH 8.1; gradual, smooth boundary.

B21t--7 to 9 inches, brown (10YR 4/3) sandy clay loam, dark brown (10YR 3/3) when moist; moderate, medium, prismatic structure parting to strong, medium, subangular blocky; very hard when dry, firm when moist; slightly calcareous; thin patchy clay skins; pH 9.1; clear, smooth boundary.

B22t--9 to 12 inches, brown (10YR 5/3) sandy clay loam, brown (10YR 4/3) when moist; moderate, medium, prismatic structure parting to moderate, medium, subangular blocky; very hard when dry, friable when moist; moderately calcareous; few patchy clay skins; pH 9.4; clear, smooth boundary.

B3ca--12 to 16 inches, light brownish-gray (10YR 6/2) clay loam, dark grayish brown (10YR 4/2) when moist; weak, coarse, prismatic structure parting to weak, medium, subangular blocky; hard when dry, friable when moist; highly calcareous; few patchy clay skins; pH 9.4; gradual, smooth boundary.

C1ca--16 to 34 inches, light-gray (10YR 7/1) clay loam and sandy clay loam, gray (10YR 5/1) when moist; massive; slightly hard when dry, friable when moist; few, fine, prominent mottles of reddish brown (5YR 4/4); highly calcareous; pH 9.4; clear, smooth boundary.

IIC2--34 to 60 inches, light brownish-gray (10YR 6/2) sand, dark grayish brown (10YR 4/2) when moist; common, medium, prominent mottles of reddish brown (5YR 4/4); single grain; loose; weakly calcareous; pH 9.5.

The texture of the A horizon ranges from loamy sand to light sandy clay loam. The texture of the B2 horizon ranges from loam to light clay loam or sandy clay loam. Texture of the upper part of the C horizon ranges from loam to clay loam. Reaction of the A horizon ranges from 7.9 to 10.0 in pH value. Depth to sand or gravel is 24 to 40 inches. Content of exchangeable sodium in the B and C horizons ranges from 30 to 85 percent, and the pH value in those horizons is 8.5 to 10.0

San Luis sandy loam (0 to 1 percent slopes) (Se).--This poorly drained soil occupies low areas on an alluvial flood plain in the northwestern part of Alamosa Area. It has a high water table and contains moderate to strong accumulations of salts within the rooting zone. The water table rises to within 1 foot of the surface during the growing season and fluctuates between depths of 1 and 3 feet. Surface runoff is slow. The hazard of erosion is slight.

This soil is used for alfalfa, small grains, and pasture. It also is used for potatoes in a few small areas. After drainage and leaching, most crops adapted to the area can be grown with irrigation. Most of the acreage of this soil is used for range. Capability units IIIsw-5 (irrigated) and VIw-2 (nonirrigated); Salt Flats range site.

San Luis sandy loam, drained (0 to 1 percent slopes) (Sf).--This somewhat poorly drained, nearly level soil occupies areas on an alluvial flood plain in the northwestern part of the survey area. It has been drained but is slightly saline. It has the profile described as representative for the San Luis series. The water table is 3 to 6 feet below the surface. Some of the salts have been leached out. Surface runoff is slow. The hazard of erosion is moderate.

All locally adapted crops are grown in irrigated areas. Some of this soil is used for range. Capability units IIIsw-4 (irrigated) and VIw-2 (nonirrigated); Salt Flats range site.

San Luis-Corlett complex, undulating (SlB).--This complex consists mainly of San Luis sandy loam and Corlett sand in such patterns that it is impractical to use or manage the two soils separately. The profiles are the ones described as representative for their respective series. Most of this complex occurs in the eastern and northeastern parts of the survey area. The San Luis soil occurs in low, flat basins between dunes. The dunes are composed of Corlett sand and included small areas of Space City soils. In most places there is water from artesian wells or water from wells in adjacent areas that contribute to the poor drainage in the low areas. Surface runoff is slow. The hazard of soil blowing is severe if the vegetative cover is inadequate.

The San Luis soil makes up 30 to 70 percent of this complex, and Corlett sand makes up 30 to 70 percent. A small percentage consists of inclusions of Space City soils and Mosca loamy sand. In areas having a higher percentage of the San Luis soil, there is a correspondingly smaller percentage of the Corlett soil.

The vegetation in the low areas is saltgrass and some alkali sacaton and greasewood. Saltgrass also grows on the sides of the smaller dunes, and greasewood grows near the tops. The larger dunes may have some Indian ricegrass on the tops, but they normally have only greasewood. The soils of this complex are used for livestock grazing and wildlife habitat. The wet areas around artesian wells are in meadow hay. These are good nesting areas for ducks and provide duck hunting. Capability unit VIw-2 (nonirrigated); San Luis sandy loam is in Salt Flats range site; Corlett sand is in Sand Hummocks range site.

San Luis-Gravelly land complex (0 to 1 percent slopes) (Sm).--This complex consists mainly of San Luis sandy loam, drained; Mosca loamy sand; and shallow or very shallow, gravelly soils. The soils occur in such intricate patterns that it is impractical to separate them on the soil map. This complex occurs on alluvial fans along the north side of the Rio Grande River bottoms. Old river channels and oxbows cross areas of San Luis and Mosca soils, creating the intricate soil pattern. Gravelly land consists mainly of exposed gravel bars. The soils are level to undulating. Surface runoff is slow. The hazard of erosion is moderate if the vegetative cover is inadequate.

The San Luis soil makes up 20 to 40 percent of this complex; the Mosca soil, 20 to 40 percent; and Gravelly land and Graypoint soils, 20 to 40 percent. In some places the Gunbarrel soils make up as much as 5 percent of the complex.

The vegetation is rabbitbrush, greasewood, saltgrass, and alkali sacaton, as well as some ring muhly and blue grama. The soils of this complex are suited to most adapted crops and cropping sequences, and most areas are used for irrigated crops and pasture. Small nonirrigated areas are used for range. Capability units IVs-2 (irrigated) and VIIs-4 (nonirrigated); San Luis soil is in Salt Flats range site; Gravelly land is not in a range site.

Space City Series

The Space City series consists of somewhat excessively drained, coarse-textured, sloping, calcareous soils in areas along the eastern edge of the San Luis Valley and on low ridges on the valley floor. The sandy material is mostly of igneous origin and has been washed down on the alluvial fans and subsequently reworked by wind.

In a representative profile, the surface layer is dark grayish-brown loamy fine sand that is noncalcareous, moderately alkaline, and about 9 inches thick. Below the surface layer is dark grayish-brown loamy fine sand. It is noncalcareous to a depth of about 30 inches and is moderately calcareous below that depth. This layer has visible lime spots in the lower 30 inches.

Space City soils have rapid permeability and low available water holding capacity.

The vegetation consists of blue grama, spiny muhly, short and tall rabbitbrush, greasewood, and four-wind saltbush. These soils are used mainly for range. Some small areas are used for irrigated crops and pasture.

Representative profile of Space City loamy fine sand, 0 to 3 percent slopes, 20 feet east of the northwest corner of sec. 30, T. 38 N., R. 13 E.:

A1--0 to 9 inches, grayish-brown (10YR 5/2) loamy fine sand, dark grayish brown (10YR 4/2) when moist; very weak, very fine, granular structure; soft when dry, very friable when moist; pH 8.1; noncalcareous; gradual, smooth boundary.

C1--9 to 30 inches, brown (10YR 5/3) loamy fine sand, dark grayish brown (10YR 4/2) when moist; single grain; loose; pH 8.3; clear, smooth boundary.

C2ca--30 to 48 inches, brown (10YR 5/3) loamy fine sand, dark grayish brown (10YR 4/2) when moist; single grain; loose; moderately calcareous; pH 8.4; gradual, smooth boundary.

C3ca--48 to 60 inches, light brownish-gray (10YR 6/2) loamy sand, brown (10YR 4/3) when moist; massive; soft when dry, very friable when moist; moderately calcareous; lime spots visible; pH 8.4.

The texture ranges from loamy fine sand to fine sand throughout the profile. In places there are a few lime-coated pebbles on the surface. The soil commonly is leached of lime to a depth ranging from 15 to 30 inches. The pH value ranges from 7.9 to 8.4 in the A horizon and from 7.9 to 8.4 in the C horizon. The alkali substratum phase has pH values in the lower part of the C horizon ranging from 8.5 to 10.0.

Space City loamy fine sand, 0 to 3 percent slopes (SpB).--This sloping soil occupies areas along the base of Mount Blanca and a few isolated low ridges on the valley floor. It has the profile described as representative for the Space City series. Surface runoff is very slow. The hazard of erosion is very severe if the vegetative cover is removed.

Included in mapping are small areas of Costilla soils.

This soil is used mainly for range that is grazed by cattle, antelope, and deer. Some small areas on the valley floor are under irrigation and are used for alfalfa, potatoes, and small grains. These areas generally are included in fields made up mostly of other soils. Capability units IVe-1 (irrigated) and VIIe-1 (nonirrigated); Sandy Bench range site.

Space City loamy fine sand, alkali substratum, 0 to 3 percent slopes (SrB).--This soil occupies low ridges on the valley floor, mainly in the northeastern part of the survey area. A few small areas are southwest of the Rio Grande River. The soil has a profile similar to the one described as representative for the Space City series, except that it has a deep water table and is very strongly alkaline at a depth below 24 inches. Because the soil is less alkaline above this depth, shallow-rooted plants can grow in it, and so can grasses that are not alkali tolerant. In addition, however, the soil is suited to deep-rooted, alkali-tolerant plants, such as greasewood and four-wing saltbush. Surface runoff is slow. The hazard of erosion is very severe if the vegetative cover is removed.

Included in mapping are a few small areas of Corlett soils. Also included are small areas of Cotopaxi sand.

This soil is used mainly for range. Indian ricegrass, blue grama, sand dropseed, spike dropseed, short and tall rabbitbrush, four-wind saltbush, and some greasewood make up the vegetative cover. A few small areas are irrigated and are used for alfalfa. Capability units IVe-1 (irrigated) and VIIe-4 (nonirrigated); Valley Sand range site.

Space City-Hooper complex, hilly (StE).--This complex consists of Space City loamy fine sand, alkali substratum; Hooper loamy sand; and, in small basins, Hooper clay loam. These soils are in such intricate patterns that it is impractical to separate them on the soil map.

The Space City soil occupies dune areas and makes up 40 to 60 percent of the complex. The Hooper soils occur in low areas between the dunes and make up 40 to 60 percent of the complex. Surface runoff is very slow. The hazard of soil blowing is very severe if the vegetative cover is not maintained.

The vegetation on the Space City soil consists of spiny muhly, blue grama, Indian ricegrass, spike dropseed, rabbitbrush, and some greasewood. The vegetation on Hooper loamy sand is saltgrass, alkali sacaton, and greasewood. Hooper clay loam supports only a few stunted greasewood plants. This complex is used as range for livestock and wildlife. Capability unit VIIe-4 (nonirrigated); Space City soil is in Valley Sand range site; Hooper loamy sand is in Salt Flats range site; Hooper clay loam is not in a range site.

Uracca Series

The Uracca series consists of somewhat excessively drained, moderately steep, very cobbly soils on alluvial fans at the foot of the Sangre de Cristo Range along the eastern edge of the San Luis Valley. These soils formed in alluvium, and there are many large cobblestones of acid igneous origin throughout the soil and covering a large part of the surface. Depth to cobblestones and gravel commonly is less than 2 feet.

In a representative profile, the surface layer is very dark grayish-brown very cobbly loam. It is noncalcareous, moderately alkaline, and about 4 inches thick, and approximately 60 percent cobblestones. The subsoil is dark-brown or very dark grayish-brown very cobbly clay loam and very cobbly coarse sandy loam that is noncalcareous, moderately alkaline, and about 9 inches thick. It is 60 to 75 percent cobblestones throughout. The substratum is dark-brown and dark grayish-brown very cobbly coarse loamy sand or very cobbly coarse sandy loam. It is noncalcareous in the upper part, is moderately calcareous in the lower part, and is moderately alkaline. This layer is about 75 percent cobblestones, and the percentage of cobblestones increases with depth. Between depths of 23 and 60 inches are cobblestones, gravel, and some boulders.

Uracca soils have moderate permeability in the subsoil and very rapid permeability in the substratum. They have very low available water holding capacity.

The vegetation is pinyon pine, juniper, mountain muhly, blue grama, Arizona fescue, junegrass, muttongrass, needle-and-thread, rabbitbrush, fringed sage, and mountain-mahogany. These soils are used as range for limited livestock grazing and for wildlife cover.

Representative profile of Uracca very cobbly loam, 15 to 35 percent slopes, 0.1 mile west and 0.15 mile north of the southeast corner of sec. 5, T. 29 S., R. 73 W.:

A1--0 to 4 inches, grayish-brown (10YR 5/2) very cobbly loam, very dark grayish brown (10YR 3/2) when moist; weak and moderate, medium, granular structure; soft when dry, friable when moist; noncalcareous; pH 8.2; approximately 60 percent cobblestones; clear, smooth boundary.

B2t--4 to 9 inches, brown (10YR 5/3) very cobbly clay loam, very dark grayish brown (10YR 3/2) when moist; weak to moderate, medium, subangular blocky structure; hard when dry, firm when moist; thin patchy clay films on soil aggregates; noncalcareous; pH 8.0; clear, wavy boundary.

B3--9 to 13 inches, brown (10YR 5/3) very cobbly coarse sandy loam, dark brown (10YR 4/3) when moist; weak, coarse, subangular blocky structure; slightly hard when dry, very friable when moist; thin very patchy clay skins; noncalcareous; pH 8.0; about 75 percent cobblestones; clear, smooth boundary.

C1--13 to 17 inches, brown (10YR 5/3) very cobbly coarse loamy sand, dark brown (10YR 4/3) when moist; single grain; loose; noncalcareous, except for coatings on undersides of cobblestones; pH 8.4; about 75 percent cobblestones; clear, smooth boundary.

C2ca--17 to 23 inches, pale-brown (10YR 6/3) very cobbly coarse sandy loam, dark grayish brown (10YR 4/2) when moist; single grain; loose; moderately calcareous; pH 8.2; about 85 percent cobblestones.

C3--23 to 60 inches, cobblestones, gravel, and some boulders; pH 8.0.

The cobblestone content ranges from 50 to about 70 percent on the surface and increases with depth. The texture of the B2 horizon ranges from heavy loam to clay loam, and thickness ranges from 4 to 12 inches. Thickness of the solum ranges from 12 to 25 inches, and lime may vary in depth and concentration. The pH value is 7.9 to 8.4 throughout.

Uracca very cobbly loam, 15 to 35 percent slopes (UrF).--This moderately steep soil occupies alluvial fans on the base of slopes of Mount Blanca and the Sangre de Cristo Range. It is a very cobbly soil that is crossed by numerous dry washes and old gullies. In many places the entire surface layer is covered with cobblestones and boulders that range up to several feet in diameter and are rounded and smooth (pl. IV, top). Surface runoff is slow because the soil is so cobbly. Many streams that originate in the mountains disappear into these fans. The hazard of erosion is only slight, although there are many old gullies.

Included in mapping are small areas of Comodore soils and a small area of a less cobbly soil that is located on a bench at higher elevations and in a higher rainfall area. This included soil is covered mainly by grasses, not by pinyon pine or juniper. Also included are small areas of Saguache and Mount Home soils. In addition, there are some included areas of cobblestones and boulders that do not have a soil profile.

This soil is used mainly for limited sheep and cattle grazing and for cutting of fenceposts and firewood. It provides food and cover for a large population of deer. Capability unit VIIs-2 (nonirrigated); not in a range site.

Vastine Series

The Vastine series consists of poorly drained, nearly level soils on low bottom lands along major creeks in the southwestern part of the survey area. These soils formed in moderately fine textured, stratified alluvial material and are underlain by sand.

In a representative profile, the surface layer is black loam about 10 inches thick. It is slightly calcareous in the upper 2 inches, is noncalcareous in the lower part, and is moderately alkaline. The subsoil is sandy clay loam about 20 inches thick. It has variegated colors of dark grayish brown, dark gray, and olive brown. It is noncalcareous and moderately alkaline. The substratum is dark-gray sand or loamy sand that is noncalcareous, is moderately alkaline, and extends to a depth of 60 inches or more.

Vastine soils have a water table that normally is at a depth of about 20 inches but fluctuates between depths of 1 foot and 2 1/2 feet with the height of the water in the creek. In spring most areas are flooded from overflowing creeks, but in fall the water table may drop to a depth of about 3 feet in places. Permeability is moderate or moderately slow. The available water holding capacity is moderate.

The vegetation consists of sedges, rushes, saltgrass, and water-tolerant grasses. These soils are used for irrigated crops, pasture, and range.

Representative profile of Vastine loam, 2,250 feet east and 300 feet north of the southwest corner of sec. 30, T. 38 N., R. 9 E.:

A1--0 to 10 inches, dark-gray (10YR 4/1) loam, black (10YR 2/1) when moist and crushed; weak to moderate, fine, subangular blocky structure parting to moderate, medium, granular; hard when dry, firm when moist; mostly noncalcareous, but slightly calcareous in upper 2 inches; pH 8.4; abrupt, smooth boundary.

B2g--10 to 30 inches, variegated light brownish-gray (2.5Y 6/2), gray (N 5/0), and light olive-brown (2.5Y 5/6) sandy clay loam, dark grayish brown (2.5Y 4/2), dark gray (N 4/0), and olive brown (2.5Y 4/6) when moist; weak to moderate, medium, subangular blocky structure; very hard when dry, firm when moist; noncalcareous; pH 8.0; abrupt, smooth boundary.

IICg--30 to 60 inches, gray (10YR 5/1) sand or loamy sand, dark gray (10YR 4/1) when moist; single grain; loose when dry, loose when moist; noncalcareous; pH 8.4; this horizon often stratified with finer textured material.

The A horizon ranges from 6 to 14 inches in thickness and from loam to clay loam in texture. The B2g horizon ranges from loam to clay loam. Depth to the underlying sand ranges from 24 to 40 inches. The pH value is 7.4 to 8.4 throughout the profile.

Vastine loam (0 to 1 percent slopes) (Va).--This soil occupies low bottom lands along the Alamosa River and LaJara and Rock Creeks (pl. IV, bottom left). Surface runoff is slow. The hazard of soil blowing is slight.

Included in mapping are small areas of Alamosa loam and of Nortonville loam.

This Vastine soil is used mainly for range and irrigated meadow. Small grains and alfalfa are grown, but the soil generally is too wet for crops that need cultivation in summer. In spring much of this soil is flooded from overflowing creeks, and in the fall the water table may drop to a depth of about 3 feet in places. Capability units IIIw-1 (irrigated) and Vw-1 (nonirrigated); Wet Meadow range site.

Villa Grove Series

The Villa Grove series consists of mainly moderately fine textured, well-drained soils. In places these soils are seeped by irrigation water and are moderately to strongly saline. They are on an alluvial flood plain on low ridges that are slightly higher in elevation than the surrounding area. They formed in calcareous alluvial material.

In a representative profile, the surface layer is dark-brown sandy clay loam about 8 inches thick. It is moderately calcareous and moderately alkaline. The subsoil is dark-brown clay loam and sandy clay loam about 26 inches thick. It is moderately calcareous in the upper part and highly calcareous in the lower 12 inches, and it is moderately alkaline. The substratum consists of dark-brown sandy loam to a depth of 44 inches and yellowish-brown silty clay loam between depths of 44 and 60 inches. It is highly calcareous and moderately alkaline. It contains some visible gypsum crystals in the lower part.

Villa Grove soils have moderately slow permeability and high available water holding capacity.

The vegetation is rabbitbrush, greasewood, saltgrass, and alkali sacaton. These soils are used for irrigated crops, pasture, and range.

Representative profile of Villa Grove sandy clay loam, 0 to 1 percent slopes, 500 feet south and 1,120 feet west of the northeast corner of sec. 21, T. 37 N., R. 9 E.:

Ap--0 to 8 inches, brown (10YR 5/3) sandy clay loam, dark brown (10YR 3/3) when moist; moderate, medium, granular structure; slightly hard when dry, friable when moist; moderately calcareous; pH 8.4; clear, smooth boundary.

B21t--8 to 16 inches, brown (10YR 5/3) clay loam, dark brown (10YR 3/3) when moist; moderate, coarse, subangular blocky structure and moderate, fine, subangular blocky; hard when dry, firm when moist; thin nearly continuous clay skins; moderately calcareous, with some small salt spots; pH 8.2; clear, smooth boundary.

B22t--16 to 21 inches, pale-brown (10YR 6/3) clay loam, dark brown (7.5YR 4/4) when moist; moderate, medium, prismatic structure parting to moderate, medium, subangular blocky; hard when dry, firm when moist; thin nearly continuous clay skins; moderately calcareous, with some salt spots; pH 8.2; clear, smooth boundary.

B3ca--21 to 34 inches, pale-brown (10YR 6/3) sandy clay loam, dark brown (10YR 4/3) when moist; weak, coarse, subangular blocky structure; slightly hard when dry, friable when moist; highly calcareous, with large lime spots; pH 8.2; clear, smooth boundary.

C1ca--34 to 44 inches, pale-brown (10YR 6/3) sandy loam, dark brown (10YR 4/3) when moist; massive; slightly hard when dry, very friable when moist; highly calcareous; pH 8.3; clear, smooth boundary.

C2cs--44 to 60 inches, light yellowish-brown (10YR 6/4) silty clay loam, yellowish brown (10YR 5/4) when moist; massive; slightly hard when dry, very friable when moist; highly calcareous, with considerable gypsum; pH 8.2.

The A horizon ranges from loam to sandy clay loam in texture and from 4 to 8 inches in thickness. Reaction of the A horizon ranges from 7.9 to 9.0 in pH value. The B horizon ranges from sandy clay loam to clay loam and is 16 to 26 inches thick. Its pH value is 7.9 to 8.4. Depth to the lime zone varies, and gypsum content ranges from slight to moderately strong accumulations. Depth to sand and gravel generally is 4 to 6 feet.

Villa Grove sandy clay loam, 0 to 1 percent slopes (VgA).--This nearly level soil occupies flood plains on the Alamosa fan in the southwestern part of the survey area. It is nonsaline to slightly saline. It has the profile described as representative for the Villa Grove series. Surface runoff is slow. The hazard of soil blowing is slight to moderate in nonirrigated areas if the vegetative cover is removed.

Included are areas of Zinzer soils that make up as much as 15 percent of any given area mapped as this Villa Grove soil. Also included are areas of Acacio or San Arcacio soils. These inclusions make up as much as 5 percent of any given area. Also included are small areas of Villa Grove sandy clay loam, saline.

This soil is used for all crops commonly grown in the county. Some areas are used for range. Capability units IIIs-1 (irrigated) and VIIs-3 (nonirrigated); Salt Flats range site.

Villa Grove sandy clay loam, saline, 0 to 1 percent slopes (VlA).--This nearly level or slightly depressed soil occupies areas on flood plains of the Alamosa fan in the southwestern part of the survey area. It has a profile similar to the one described as representative for the Villa Grove series, except that it is moderately to strongly saline and is seeped from irrigation water. It has a water table that fluctuates between depths of 2 and 4 feet and is highest during the irrigation season and lowest

in winter. Surface runoff is slow. The hazard of erosion is slight.

Included are areas of Zinzer loam, saline, that make up as much as 15 percent of any given area mapped as this Villa Grove soil. Also included are areas of San Arcacio or Acacio soils. These soils make up as much as 5 percent of any given area.

This soil is used for irrigated crops and pasture. Some areas are used for range. Capability units IIIsw-1 (irrigated) and VIw-2 (nonirrigated); Salt Flats range site.

Villa Grove sandy clay loam, saline, 1 to 3 percent slopes (VlB).--This gently sloping soil occupies the edges of old terrace ridges on the Alamosa fan in the southwestern part of the survey area. These ridges are slightly higher in elevation than the surrounding area. The soil occurs in long, narrow strips. This soil has a profile similar to the one described as representative for the Villa Grove series, except that it is seeped from irrigation water and has a water table that fluctuates between depths of 2 and 4 feet. It also has a moderate to strong accumulation of salts on the surface and in the rooting zone. Surface runoff is medium. The hazard of erosion is moderate.

Included in mapping are areas of Zinzer loam, 1 to 3 percent slopes. This soil makes up as much as 15 percent of any given area mapped as this Villa Grove soil. Also included are small areas of San Arcacio and Acacio soils.

Most of this soil is used for range. Some areas are used for irrigated crops of small grain and alfalfa. Other areas are used for irrigated pasture. Capability units IIIew-1 (irrigated) and VIw-2 (nonirrigated); Salt Flats range site.

Wet Alluvial Land

Wet alluvial land (0 to 1 percent slopes) (Wa) is on low, nearly level flood plains along the Rio Grande River. It is poorly drained and contains moderate to strong accumulations of salts.

Wet alluvial land consists of moderately deep, alluvial soils that are underlain by sand and gravel at a depth of 2 to 4 feet. Their texture ranges from loam to clay loam, and they are commonly stratified. The water table rises to within 12 to 24 inches of the surface during the growing season. The available water holding capacity is moderate to high. Permeability is moderately slow to moderate. Surface runoff is slow. The hazard of erosion is slight.

The vegetation is saltgrass, alkali sacaton, sedges, and rushes, and there are some rabbitbrush and greasewood plants. This land type is used for irrigated crops, pasture, and range. Potatoes and other vegetable crops are not suited to these soils. Alfalfa and small grains are affected by salts and the water table. Capability units IIIw-2 (irrigated) and VIw-1 (nonirrigated); Salt Meadow range site.

Zinzer Series

The Zinzer series consists of well-drained, nearly level soils on flood plains of the valley floor. These soils occupy areas that are slightly higher in elevation than surrounding areas. In places the soils are seeped by irrigation water and have a seasonal high water table. They formed in calcareous, mixed alluvium.

In a representative profile, the surface layer is dark-brown loam that is moderately calcareous, moderately alkaline, and about 9 inches thick. The next layer is dark-brown sandy clay loam that is moderately calcareous, moderately alkaline, and about 3 inches thick. The upper 11 inches of the substratum is light-brown sandy clay loam that is highly calcareous with much visible lime and is moderately alkaline. The next 10 inches is dark-brown sandy loam that is also highly calcareous. The lower part of the substratum is sandy clay loam that is highly calcareous and contains a few lime and gypsum spots. This layer extends to a depth of 60 inches or more.

Zinzer soils have moderate permeability and high available water holding capacity.

The vegetation is alkali sacaton, saltgrass, rabbitbrush, and some greasewood. These soils are used for irrigated crops, pasture, and range.

Representative profile of Zinzer loam, 0 to 1 percent slopes, 2,040 feet south and 100 feet west of the northeast corner of sec. 28, T. 37 N., R. 9 E.:

Ap--0 to 9 inches, brown (7.5YR 5/4) loam, dark brown (10YR 3/3) when moist; weak, medium, subangular blocky structure parting to weak, fine, granular; slightly hard when dry, friable when moist; moderately calcareous; pH 8.2; clear, smooth boundary.

AC--9 to 12 inches, brown (7.5YR 5/4) sandy clay loam, dark brown (10YR 4/3) when moist; weak, coarse, subangular blocky structure parting to weak, fine, granular; slightly hard when dry, friable when moist; moderately calcareous, with a few white specks; pH 8.2; clear, smooth boundary.

C1ca--12 to 23 inches, pinkish-white (7.5YR 8/2) sandy clay loam, light brown (7.5YR 6/4) when moist; very weak, medium, subangular blocky structure and weak, fine, granular; slightly hard when dry, firm when moist; highly calcareous, with much visible carbonate; pH 8.2; clear, smooth boundary.

C2ca--23 to 33 inches, pale-brown (10YR 6/3) sandy loam, dark brown (10YR 4/3) when moist; massive; slightly hard when dry, very friable when moist; highly calcareous; pH 8.2; clear, smooth boundary.

C3cacs--33 to 60 inches, very pale brown (10YR 7/3) light sandy clay loam, brown (10YR 5/3) when moist; massive; slightly hard when dry, friable when moist; highly calcareous, with a few small gypsum and calcium carbonate spots in the lower part; pH 8.0.

Comodore extremely rocky loam, 40 to 150 percent slopes, on the eastern edge of the survey area. This soil is a good habitat for deer.

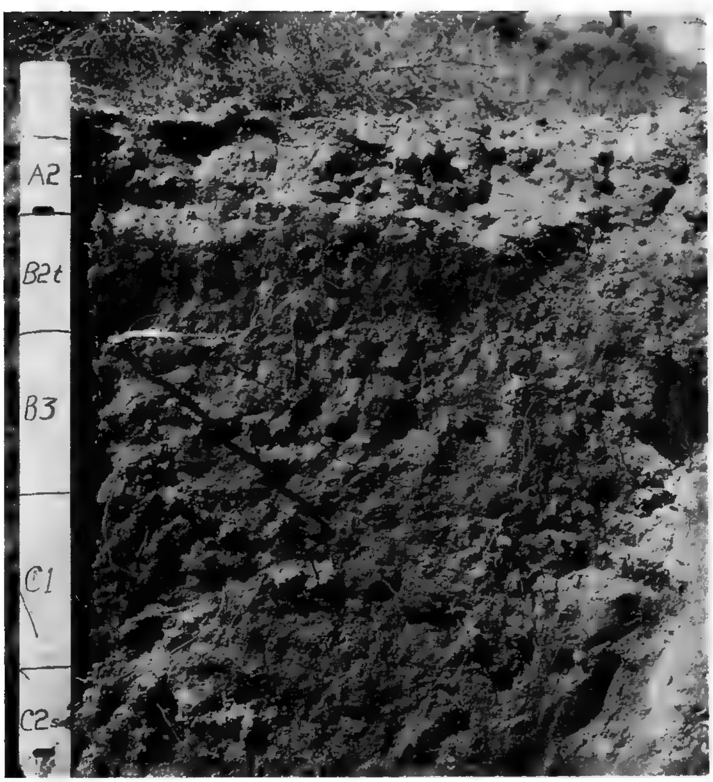
Landscape of Costilla loamy sand, 0 to 2 percent slopes. Mount Blanca is in the background. The vegetation is blue grama and little rabbitbrush.

Dune land consists of sand piled in dunes several hundred feet high. This is mostly in the Great Sand Dunes National Monument and is an important tourist attraction. The creek in the foreground is about one-fourth mile wide and flows only in spring.

PLATE II

Profile of Graypoint gravelly sandy loam.

A stand of western wheatgrass, alkali sacaton, greasewood, saltgrass, and rabbitbrush on nearly level Hapney loam. Mount Blanca is in the background.



Profile of Hooper clay loam.

An area of Hooper soils in an irrigated meadow. The bare areas are Hooper clay loam, and the areas with grass are Hooper loamy sand.

Laney loam is nearly level and, in this area, supports a dense stand of tall rabbitbrush.

Profile of Mount Home very cobbly sandy loam in an area of Mount Home - Sagauche cobbly sandy loams, 4 to 12 percent slopes.

Flood irrigation of meadow on Nortonville loam.

Area of Uracca very cobbly loam, 15 to 35 percent slopes. This is ideal habitat for deer and provides good cover and food.

Vastine loam is on low bottom lands near creeks and is subject to flooding. It has a high water table.

This artesian well used for irrigation is 596 feet deep and free-flows 2,500 gallons per minute. It is equipped with a valve to regulate the flow. It also is equipped with a turbine pump that can be run with an engine and that pumps about 4,000 gallons per minute.

Field of barley on Mosca loamy sand and San Luis sandy loam that are irrigated with a self-propelled sprinkler system. This system has a pipe one-fourth mile long and rotates around a central point. It irrigates a circular area having a radius of one-fourth mile.

Baled alfalfa on Gunbarrel loamy sand.

This concrete ditch on Gunbarrel loamy sand delivers water from the irrigation wells to the desired location without seepage loss. It helps to make possible the efficient use of water, soil, and labor.

Cottonwood trees and understory of grass on Sandy alluvial land provide considerable grazing for stock and make good cover for wildlife.

Typical area of Alkali Overflow range site on Hooper soils, occasionally flooded. The vegetation here is almost entirely saltgrass. Clumps of brush on Sand Hummocks range site are in background.

Typical vegetation on Salt Flats range site. Clumps of alkali sacaton appear slightly darker than the shorter saltgrass. The brush is rubber rabbitbrush and greasewood.

Typical area of Deep Sand range site on Cotopaxi sand, hilly. The light-colored grass is Indian ricegrass. Darker clumps are sandhill muhly. A few plants of rabbitbrush are in center of picture and scattered throughout. Large sand dunes are at foot of mountain range in far background.

The A horizon ranges from loam to sandy clay loam in texture. The C horizon ranges from heavy sandy loam to light clay loam and sandy clay loam. This horizon may contain thin layers of light sandy loam. The pH value ranges from 7.9 to 8.4 The lime zone contains about 15 to 25 percent calcium carbonate, and some gypsum normally is present. Depth to sand ranges from 40 to more than 60 inches.

Zinzer loam, 0 to 1 percent slopes (ZnA).--This nearly level soil occupies flood plains in the southwestern part of the survey area. These flood plains are slightly higher in elevation than the surrounding landscape. This soil is nonsaline to slightly saline. It has the profile described as representative for the Zinzer series. Salinity is not strong enough to affect crops that are normally grown in the survey area. Surface runoff is slow. The hazard of soil blowing is slight to moderate in nonirrigated areas if the vegetative cover has been removed.

Included in mapping are small areas of McGinty, Acacio, or Villa Grove soils and isolated small spots of San Arcacio soils.

Where irrigated, this soil is used for most locally adapted crops. It also is used for irrigated pasture. Vegetable crops are grown to a large extent on this soil. Some areas are used for range. Capability units IIIs-1 (irrigated) and VIIs-3 (nonirrigated); Salt Flats range site.

Zinzer loam, saline, 0 to 1 percent slopes (ZoA).--This nearly level to slightly depressed soil occupies flood plains in the southwestern part of Alamosa Area. It is poorly drained and moderately to strongly saline. This soil has a profile similar to the one described as representative for the Zinzer series, except that crops are affected by a fluctuating water table and the salt content. The water table ranges between depths of 2 and 5 feet and is highest during the irrigation season and lowest in winter. The surface commonly is covered by an accumulation of white salt because of the high water table. Surface runoff is slow. The hazard of erosion is slight.

In the less saline areas, this soil is used for all locally grown crops. Salt-tolerant crops should be planted in undrained areas, and water-tolerant grasses and legumes are needed for pasture and hayland plantings. Many areas are used for range. Capability units IIIsw-1 (irrigated) and VIw-2 (nonirrigated); Salt Flats range site.

Zinzer loam, 1 to 3 percent slopes (ZnB).--This gently sloping soil occupies flood plains in the southwestern part of the survey area along the edges of ridges that are slightly higher in elevation than the surrounding area. It generally occurs in long, narrow strips of limited extent. The lower edges of these strips generally are bordered by shallow or moderately deep soils over gravel. Surface runoff is medium. The hazard of erosion is moderate in nonirrigated areas if the vegetation has been removed.

Included in mapping are areas of Acacio or Villa Grove soils that have slopes of 1 to 3 percent. These soils make up as much as 10 percent of any given area mapped as this Zinzer soil. Also included are some very small spots of San Arcacio soils.

Most of this soil is used for range. Some areas are used for alfalfa, small grains, and pasture. Capability units IIIe-1 (irrigated) and VIIs-3 (nonirrigated); Salt Flats range site.

USE AND MANAGEMENT OF THE SOILS

In this section the management of irrigated soils is discussed and the capability grouping used by the Soil Conservation Service is explained. Next, the capability units are discussed in detail and predicted yields are given of the principal irrigated crops. Then, the section gives information about management of the soils for range, for wildlife, and for recreation. The final part discusses engineering uses of the soils.

Management of Irrigated Soils

About 140,000 acres are irrigated in the Alamosa Area. This does not include naturally wet or seeped areas for which systems of irrigation have not been developed. It does include about 30,000 acres of meadowland that is naturally wet and has a high water table. An additional 60,000 acres of soils are suitable for irrigation and could be irrigated if water were available.

This subsection describes briefly some of the management practices that are important to the use and management of the irrigated soils in the survey area. It also gives some guidelines for more efficient use of irrigation water for different kinds of soil.

Sources of Irrigation Water

Irrigation water in the Alamosa Area is obtained from two main sources. Most of the water is diverted from the Rio Grande River and various creeks, but some is pumped from subsurface water.

The Rio Grande River is the main source of irrigation water. Water is diverted from the river into several canals that carry it to farms and ranches. The Empire Canal carries most of the water for the San Arcacio-Zinzer soil association. The Gunbarrel-Mosca-San Luis soil association is served mainly by the San Luis, Farmers, Union, and Prairie Canals.

The Alamosa-Vastine-LaJara soil association is served mainly by the Costilla and Excelsior Canals and by diversion from Alamosa and LaJara Creeks. Some small areas are irrigated by other canals. One small area is irrigated from Big Spring and Sand Creeks.

Some of the ditch companies have storage reservoirs in the San Juan Mountains to the west of the survey area. Spring runoff is stored in these reservoirs to be used later in summer when streamflow is low. Snow depth and water content of the snow are measured on the watershed during winter. From the information obtained, predictions for streamflow in spring and summer and the amount of water available for irrigation can be made more accurately.

Pumping from wells provides much of the water for irrigating soils in the southern and western parts of the survey area. Irrigation wells are an important source of water, particularly in the Gunbarrel-Mosca-San Luis soil association. Most farms use pump wells as a supplementary source of water (11). More recently developed farms use pump wells as the only source of water, because all water in rivers and creeks has been previously adjudicated.

Irrigation pump wells vary in depth and amount of water produced. In the northwestern part of the survey area, the wells are 50 to 100 feet deep and produce 1,500 to 2,000 gallons per minute. In the southwestern part of the survey area, most pump wells are 650 to 900 feet deep and produce about 800 to 1,000 gallons per minute. Some large artesian wells in the western part of the area are 600 to 2,200 feet deep (most are about 2,000 feet deep) and produce as much as 1,800 gallons per minute. These large wells are equipped with a valve to regulate the flow of water, and when water is not needed for irrigation, the flow can be shut off (pl. IV, bottom right).

Soil Moisture as Related to Irrigation

The purpose of irrigating is to supply crops with adequate moisture for growth. Causes for low irrigation efficiency and loss of water are penetration below the root zone, runoff at the end of the field, and seepage and ditch losses.

The available moisture is the moisture a plant can draw from the soil and maintain good growth. If the soil is not saline, this generally is about half the field capacity of the soil. After the available moisture has been drawn out of the soil, the plant begins to wilt. The amount of available moisture any soil can hold at field capacity depends on the soil texture, depth, and salt content. Silt loam, clay loam, and silty clay loam hold about 2.4 inches of available moisture per foot of soil; loam holds about 2.0 inches per foot; sandy loam about 1.4 inches per foot; and loamy sand and fine sand, about 0.8 inch per foot (19).

Field capacity is the amount of moisture a soil can hold against the force of gravity, usually the condition that exists 2 or 3 days after irrigation. Salinity in a soil decreases the available moisture because plants have a more difficult time drawing moisture from a saline soil.

Water is lost below the rooting zone if irrigation runs are too long or if water is left for too long a time at one setting. If runs are too long, or if too little water is used for the length of run, the upper end of the field often is wet below the rooting zone before the lower end is adequately irrigated. This is particularly the case in such sandy soils as Costilla soils or in soils that have a shallow rooting zone over sand. Wetting the soil below the rooting zone is of little value and often creates drainage problems.

If the size of the head of water is known, the amount of water that is applied can be calculated. One second-foot of water (450 gallons per minute) covers an acre 1 inch deep in 1 hour; in other words, it applies 1 inch of water to the soil of that acre. If all available moisture has been used up, a crop that has a 2-foot rooting zone on a clay loam or loam soil needs a 4-inch irrigation to refill the rooting zone to field capacity. The ability and ease of the soil to absorb water also must be considered as well as the permeability of the subsoil. The texture of the soil has the most bearing on the water-intake rate and permeability. The order of permeability of different soil textures, from slowest to most rapid, is as follows: clay and silty clay, clay loam and silty clay loam, loam and silt loam, fine sandy loam, sandy loam, loamy sand, and sand. The tilth of the surface layer and structure of the subsoil also have an influence on the water-intake rate and permeability.

Unfortunately, it is not always possible to irrigate at the best time, because water in irrigation ditches cannot be turned on and off at will as irrigation wells can. The best way to keep plants growing rapidly is to irrigate when half the available moisture in the upper 6 to 12 inches of soil is depleted, or when the soil contains about one-fourth of field capacity. Irrigation trials have shown that plants draw 40 percent of the moisture they use from the upper quarter of the root zone, 30 percent from the second quarter, 20 percent from the third quarter, and 10 percent from the bottom quarter. Because plants absorb the greatest part of their moisture from the upper part of the soil, the upper 6 to 12 inches generally indicates the time to irrigate. Deep-rooted crops and soils that do not have uniform-textured profiles may be exceptions to this rule.

Methods of Applying Water

The soils of the Alamosa Area are suited to one or more methods of irrigation. These methods are border irrigation, furrow irrigation, flood irrigation, sprinkler irrigation, and subirrigation.

The border irrigation method is suited to most soils. It is used on nearly level soils that are under close-growing crops. The borders may be either small dikes or small ditches from which water can be

diverted at any desired point. In this method of irrigation, the entire area between the borders is covered with water. Because low spots are ponded and high spots may be impossible to irrigate, the surface must be nearly level if the border method is to be satisfactory.

Furrow irrigation commonly is used for such row crops as potatoes, lettuce, and cabbage. This method can be used by diverting water from a concrete or earth ditch. Water is run through furrows between the rows of potatoes or other crops. This is an efficient method of irrigation, and water can be regulated and controlled well.

Flood irrigation is used mainly on soils that are used for meadow or irrigated hay. This is mostly on the Alamosa, Vastine, Nortonville, and LaJara soils. In this method, water is turned out of a ditch at the upper end of a field and allowed to flow across the field, flooding the land that is not too high for the water to cover. Some contour ditches generally are run through the field to get water on as many high places as practical. This method differs from border irrigation only in that no borders are used to control the water, and therefore it normally requires more water to irrigate a given acreage.

Sprinkler irrigation is used to a large extent in areas where the only source of water is from pump wells. Gunbarrel loamy sand and Mosca loamy sand are soils well suited to this method of irrigation. It is used mainly on soils planted to close-growing crops. In this method, more nearly even distribution of water can be made, and smaller applications can be made than with other methods of surface irrigation. Leveling is not needed for sprinkler irrigation, as it is for border irrigation.

Subirrigation is a method in which the water table is raised temporarily into the rooting zone of growing crops. If subirrigation is to be successful, the surface layer must be nearly level, the soil should be moderately rapidly to rapidly permeable in the substratum so that the water table can be raised or lowered in a short time, and there must be either a water table that can be raised or an impermeable layer in the lower part of the substratum to prevent deep percolation of water. The Gunbarrel, McGinty, Mosca, and San Arcacio soils are well suited to subirrigation. They are moderately rapidly to rapidly permeable, have a gravel or sand substratum, are nearly level, and have a water table that usually can be regulated.

Subirrigation is accomplished by raising the water table. To do this, small ditches are run through the fields and a small amount of water is turned into each ditch in the area to be irrigated. Check dams are put in the ditches at intervals. Water fills the ditch behind each dam, then flows around it and fills the ditch behind the next lower dam. In most of the subirrigated areas, drainage ditches are built with periodic checks that can be used to raise or lower the water level in the drainage ditch. When the water level in the ditch is raised, adjacent fields can more easily be subirrigated. When the field has been sufficiently irrigated, the check is released and the water in the drain is lowered, and this in turn lowers the water table in the field. Fields in subirrigated areas also are designed so they can be surface irrigated when the need arises.

Reclamation of Saline and Alkali Soils

Many soils of the Alamosa Area are affected by salts and alkali that seriously reduce crop yields or make the soil unsuitable for cultivation. Some soils contain so much alkali that only the most alkali-tolerant shrubs and grass can survive. The alkali and saline conditions have been brought about by the high water table that underlies most of the soils in the survey area.

Saline and alkali soils generally can be reclaimed or improved by drainage, leaching, and good water management. Hooper and LaSauses soils would be much more difficult to reclaim than Gunbarrel or Mosca soils because of the difference in soil texture and permeability. Experiments in the survey area have shown that some saline and alkali soils can be improved by drainage and leaching (2). Soils that are high in content of sodium commonly require a chemical amendment in order to leach the sodium out of the soil. Gypsum and sulfuric acid are two amendments that have been effective in reclaiming soils that are high in content of sodium. Gypsum is applied to the surface in granular form. Sulfuric acid is applied to the surface layer in liquid form.

The first step in reclaiming saline or alkali soils is to establish adequate drainage. The soils should be level so that irrigation water can be used to leach out salts. Before the leaching process is started, the amendment should be added to the soil. The amount of amendment depends on the concentration of the alkali.

If drains are installed in moderately coarse textured and coarse textured soils, such as Gunbarrel and Mosca soils, or in shallow soils over gravel, care should be taken not to lower the water table too much. The water table in these soils generally should not be lowered below a depth of 4 or 4 1/2 feet. If it is at a greater depth than this, an excessive amount of irrigation is required and much water is lost by deep percolation. Crop yields may also be reduced, and subirrigation may not be practical.

Some experiments have shown that, although the amount of sodium was reduced in the surface layer by use of amendments and leaching, sodium in the lower horizons was not reduced. By leaching the surface horizons, a favorable condition is provided for plant growth even though lower horizons are not leached.

Good tillage practices and the use of green manure and legumes improve tilth and help in reclaiming the soil and restoring it to high productivity. Generally, it is desirable to plant salt-tolerant crops on saline or alkali soils. Some of the crops normally grown in the survey area that have a high degree of salt tolerance are barley and sugar beets; those with a medium salt tolerance are

cabbage, cauliflower, lettuce, potatoes, peas, alfalfa, oats, and sweetclover (13).

Weed Control

Annual weeds are a problem on most of the irrigated soils in the survey area. The most common weeds are Russian-thistle, kochia, sunflower, common ragweed, and pigweed. These weeds can be controlled easily by cultivation and by spraying with chemicals. Most grain fields are sprayed to kill annual weeds. Ditchbanks and fence rows may be sprayed or burned off to kill weeds and prevent them from seeding.

Noxious weeds grow mainly in the irrigated sections of the Alamosa Area and particularly on soils that are poorly suited to use as cropland or on soils that have been idle for several years. These weeds grow along drainage ditches, road rights-of-way, and canals. The most common noxious weeds are Russian knapweed (*Centaurea repens*), povertyweed (*Iva axillaris*), Canada thistle (*Cirsium arvense*), whitetop (*Cardaria draba*), and field bindweed (*Convolvulus arvensis*) (3). These weeds are hard to kill once they have become established. They can be controlled and their seed production prevented by clean cultivation and spraying with chemicals. Soil sterilants can be used on small areas.

Capability Grouping

Capability grouping shows, in a general way, the suitability of soils for most kinds of farming. The soils are grouped according to their limitations when used for field crops, the risk of damage when they are farmed, and the way they respond to treatment. The grouping does not take into account major and generally expensive landforming that would change slope, depth, or other characteristics of the soils; does not take into consideration possible but unlikely major reclamation projects; and does not apply to horticultural crops or other crops that require special management.

Those familiar with the capability classification can infer from it much about the behavior of soils when used for other purposes, but this classification is not a substitute for interpretations designed to show suitability and limitations of groups of soils for range, for forest trees, or for engineering.

In the capability system, the kinds of soil are grouped at three levels: the capability class, the subclass, and the unit. These are discussed in the following paragraphs.

CAPABILITY CLASSES, the broadest groups, are designated by Roman numerals I through VIII. The numerals indicate progressively greater limitations and narrower choices for practical use, defined as follows:

Class I soils have few limitations that restrict their use. (None in Alamosa Area)

Class II soils have moderate limitations that reduce the choice of plants or that require moderate conservation practices. (None in Alamosa Area)

Class III soils have severe limitations that reduce the choice of plants, require special conservation practices, or both.

Class IV soils have very severe limitations that reduce the choice of plants, require very careful management, or both.

Class V soils are subject to little or no erosion but have other limitations, impractical to remove, that limit their use largely to pasture, range, woodland, or wildlife habitat.

Class VI soils have severe limitations that make them generally unsuited to cultivation and limit their use largely to pasture or range, woodland, or wildlife habitat.

Class VII soils have very severe limitations that make them unsuited to cultivation and that restrict their use largely to pasture or range, woodland, or wildlife habitat.

Class VIII soils and landforms have limitations that preclude their use for commercial plants and restrict their use to recreation, wildlife habitat, water supply, or esthetic purposes.

CAPABILITY SUBCLASSES are soil groups within one class; they are designated by adding a small letter, *e*, *w*, *s*, or *c*, to the class numeral, for example, IIe. The letter *e* shows that the main limitation is risk of erosion unless close-growing plant cover is maintained; *w* shows that water in or on the soil interferes with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage); *s* shows that the soil is limited mainly because it is shallow, droughty, or stony; and *c*, used in only some parts of the United States, shows that the chief limitation is climate that is too cold or too dry.

In class I there are no subclasses, because the soils of this class have few limitations. Class V can contain, at the most, only the subclasses indicated by *w*, *s*, and *c*, because the soils in class V are subject to little or no erosion, although they have other limitations that restrict their use largely to pasture, range, woodland, wildlife habitat, or recreation.

CAPABILITY UNITS are soil groups within the subclasses. The soils in one capability unit are enough alike to be suited to the same crops and pasture plants, to require similar management, and to have similar productivity and other responses to management. Thus, the capability unit is a convenient grouping for making many statements about management of soils. Capability units are generally designated by adding an Arabic numeral to the subclass symbol, for example, IIIs-1 or IVs-1. Thus, in one symbol, the Roman numeral designates the capability class, or degree of limitation; the small letter indicates the subclass, or kind of limitation, as defined in the foregoing paragraph; and the

Arabic numeral specifically identifies the capability unit within each subclass.

Management by Capability Units

In the following pages the capability units in the Alamosa Area are described and suggestions for use and management of the soils in each unit are given.

Except for Hooper loamy sand, all the irrigated soils in the Alamosa Area are placed in capability class III or IV. Hooper loamy sand is in class VI. Because the cold climate and short growing season are severe limitations to use of the soils for crops, no soils in the Area are placed in class I or II. In grouping the soils into irrigated capability units, it is assumed that sufficient water is available for irrigation and that the soils are irrigated. Nonirrigated soils are in class V or higher and are not suitable for cultivated crops.

The names of soil series represented are mentioned in the description of each capability unit, but this does not mean that all the soils of a given series are in the unit. To find the names of all the soils in any given capability unit, refer to the "Guide to Mapping Units" at the back of this soil survey.

Capability Unit IIIe-1

In this unit are soils of the Acacio and Zinzer series. These soils are well drained and gently sloping. They occur on terraces and flood plains in the southwestern part of the survey area. The surface layer is medium textured, and the subsoil and substratum have moderate permeability. The soils have slight to moderate salinity.

These soils are easy to work, but managing irrigation water is a little more difficult on these sloping soils than on nearly level soils. The available water holding capacity is high. The water-intake rate is moderate. Surface runoff is medium, and the hazard of erosion is slight to moderate.

These soils are suited to nearly all adapted crops, pasture, and hay plants grown under irrigation and to nearly all adapted cropping sequences. The soils should be leveled if potatoes and vegetables are to be grown as the main crops.

Suitable irrigation methods are furrow, contour furrow, contour ditch, border, and sprinkler irrigation. The length of run needs to be short to control erosion. Applications of fertilizer are needed for high production. Legumes respond to phosphorus, and nonlegumes respond to nitrogen and phosphorus. Bromegrass, orchardgrass, timothy, intermediate wheatgrass, alfalfa, red clover, and alsike clover are good plants for pasture and hay. Limited cultivation of row crops, rotational use of pastures, and applications of fertilizer are essential to high yields.

Capability Unit IIIew-1

In this unit are soils of the Villa Grove series. These soils are poorly drained and nearly level to gently sloping. They occur on terraces in the southwestern part of the survey area. The surface layer is medium textured, and the subsoil has moderately slow permeability. These soils are underlain by sand at a depth below 40 inches in some places. They are seeped from irrigation water and have a fluctuating water table at a depth of 2 to 5 feet. They have moderate to strong salinity.

These soils are easy to work. Managing irrigation water is a little more difficult on these soils than on nearly level soils because of slope. The available water holding capacity is high, but water is not readily available to many cultivated crops, because of the salinity. The water-intake rate is moderate. Surface runoff is medium, and the hazard of erosion is moderate to severe.

These soils are used for alfalfa, small grains, and pasture. They are not suited to potatoes or vegetables. The growth of small grains may be uneven, and yields are reduced by the effects of salt and the water table.

These soils need artificial drainage and leaching. Leveling the soils helps to make good management of irrigation water possible and helps to leach out salts. Suitable irrigation methods are furrow, border, and contour ditch. Irrigation requires special care to prevent aggravation of the salt and seep problem. If used for pasture or hay, these soils are suited to such adapted species as tall wheatgrass, alta fescue, Russian wildrye, reed canarygrass, red clover, sweetclover, and alsike clover.

Generally, it is practical to drain and leach these soils. If they are drained, leveled, and properly managed, they are productive.

Capability Unit IIIe-2

Mosca loamy sand is the only soil in this unit. This soil is well drained and nearly level. It is on flood plains in the subirrigated part of the survey area. The surface layer is coarse textured, and the subsoil has moderately rapid permeability. This soil is underlain by sand and gravel at a depth of 20 to 60 inches. It is nonsaline or only slightly saline, but it contains moderate to strong concentrations of alkali in the subsoil.

This soil is easy to work. The available water holding capacity is low. The water-intake rate is rapid. Surface runoff is slow, and the hazard of soil blowing is very severe.

Potatoes, alfalfa, and small grain are the main crops. Lettuce is grown to a small extent. A good rotation for this soil consists of alfalfa for 3 to 4 years, potatoes for 2 years, and a small grain with a new seeding of alfalfa.

Suitable irrigation methods are furrow, border, and sprinkler. Also suitable are ditches for subirrigation. An artificial leaching in the early part of

each year is desirable to lower the accumulation of salts. The soil must be leveled and kept smooth to provide uniform irrigation and adequate moisture. Legumes respond to phosphorus, and nonlegumes respond to nitrogen and phosphorus. The cropping system should be such that residues can be managed to provide ground cover during windy periods in spring. Emergency listing may be needed if the soil starts to blow.

Capability Unit IIew-2

Mosca loamy sand, wet, is the only soil in this unit. This soil is somewhat poorly drained and nearly level. It is on flood plains. The surface layer is coarse textured, and the subsoil has moderate to rapid permeability. This soil is underlain by sand and gravel at a depth of 20 to 60 inches. It has a high water table at a depth of 2 to 4 feet most of the year, and it is moderately saline and alkali.

This soil is easy to work. It is moderately susceptible to soil blowing if it is without a protective plant cover. The available water holding capacity is low, and soil water is not readily available to some crops because of excess salts. This soil is droughty if drained. The water-intake rate is rapid. Surface runoff is slow.

Potatoes and alfalfa generally do not grow well on this soil. Small grains normally are damaged by the high water table and excess salts.

Suitable irrigation methods include furrow, border, and sprinkler. Also suitable are ditches for subirrigation. Drainage and leaching are needed for satisfactory crop production. Without adequate drainage, the water table is hard to control and leaching is not satisfactory. Irrigation water management is important to prevent accumulation of salts and buildup of the water table. Leveling will help get better distribution of irrigation water to leach out salts.

If the soil is planted to pasture or hay, water- and salt-tolerant plants are desirable. Tall wheatgrass, Russian wildrye, reed canarygrass, meadow foxtail, alta fescue, red clover, sweetclover, alsike clover, and strawberry clover are adapted.

Capability Unit IIIs-1

In this unit are soils of the Acacio, Villa Grove, and Zinzer series. These soils are well drained and nearly level. The surface layer is medium textured, and the subsoil has moderate to slow permeability. In some places these soils are underlain by sand at a depth below 40 inches. They are nonsaline to moderately saline. In irrigated areas they normally are nonsaline to slightly saline.

These soils are easy to work, but they need good management to prevent seepage and an increase in salinity. They have high available water holding capacity. The water-intake rate is moderate. Runoff is slow, and the hazard of erosion is slight to moderate.

These soils are used for crops, permanent pasture, or hay. All locally adapted crops can be grown. The soils are especially well suited to vegetables, small grains, and alfalfa. Good management includes a cropping system with a high-residue crop, a deep-rooted legume in the rotation, and applications of fertilizer for maintaining good tilth and adequate growth of crops. These soils are not suited to subirrigation, because of their medium to moderately fine texture. Border and furrow irrigation methods with relatively long runs are suggested. Leveling and frequent planing help to make irrigation easier and more efficient. Good management of irrigation water is necessary. Legumes respond to phosphorus, and nonlegumes respond to nitrogen and phosphorus.

If used for pasture or permanent hay, these soils produce well under intensive management. They are suited to such adapted grasses as smooth brome, orchardgrass, intermediate wheatgrass, or timothy in mixture with alfalfa, red clover, or alsike clover.

Capability Unit IIIsw-1

In this unit are soils of the Acacio, Arena, Laney, Villa Grove, and Zinzer series. These soils are nearly level, and chiefly somewhat poorly drained to poorly drained. They occur on low terraces or flood plains. The surface layer is medium textured, and the subsoil has moderate to slow permeability. These soils are underlain by sand at a depth below 36 inches in some places. They are wet from seepage and have moderate to strong salinity and alkali. One soil in the unit, Laney loam, is well drained but is strongly affected by alkali.

These soils are easy to work. They have moderate to high available water holding capacity, but because of salinity, the water is not readily available to some crops. The water-intake rate is moderate. Surface runoff is slow, and the hazard of erosion is slight.

Most crops adapted to the survey area are grown to a limited extent on these soils, except that potatoes and other vegetables are not grown on Arena or Laney soils. In undrained areas, potatoes, vegetables, and alfalfa growth is reduced by effects of salt and the water table. Unless drainage is adequate pastures do best if they contain a grass, such as alta fescue, reed canarygrass, or tall wheatgrass, in mixture with sweetclover, red clover, or alsike clover. Fertilizer applications should be based on results of soil tests. The soils of this unit need drainage and leaching for good crop production. Short lengths of run permit lighter, more frequent applications of irrigation water. Suitable methods are furrow and border irrigation. Leveling helps to get more uniform application of water.

The soils are located so that drainage generally is practical and economical. Leaching after drainage

usually can be accomplished, and intensive cropping is worthwhile. Such soil amendments as sulfur, gypsum, or sulfuric acid are needed to reclaim some of the soils.

Capability Unit IIIs-2

San Arcacio sandy loam is the only soil in this unit. This soil is moderately well drained and nearly level. It occurs on flood plains and low terraces, mainly in the southwestern part of the survey area. The surface layer is medium textured to moderately coarse textured, and the subsoil has moderate permeability. This soil is underlain by gravel and sand at a depth of 20 to 36 inches. The water table is at a depth of 3 to 4 feet.

This soil is easy to work. The available water holding capacity is low, and the soil is droughty because of limited depth. The water-intake rate is moderately rapid. Surface runoff is slow, and the hazard of erosion is slight to moderate.

This soil is used for all adapted crops and is suited to all cropping sequences. It is important for vegetable crops and is used for much of the lettuce, cabbage, and cauliflower grown in the survey area. Many farmers use fertilizer and manure to maintain soil fertility, and they plant vegetables year after year. Nonlegumes grown on this soil respond to applications of nitrogen and phosphorus, and legumes respond to phosphorus. Areas used for vegetables generally are fall plowed. Frequent irrigations are needed. Maintaining the organic-matter content and fertility is important. Leveling and frequent planing are needed for efficient irrigation. Deep cuts should be avoided in leveling to keep from exposing gravel spots. Suitable irrigation methods are furrow, border, and sprinkler. Some areas are subirrigated. If this soil is seeded to permanent pasture or hay, productive mixtures are smooth brome, timothy, orchardgrass, and intermediate wheatgrass along with red clover, alsike clover, or sweetclover.

Capability Unit IIIsw-2

San Arcacio sandy loam, saline, is the only soil in this unit. This soil is somewhat poorly drained to poorly drained and is nearly level. It occurs on low terraces or flood plains in the vicinity of Waverly. The surface layer is medium textured to moderately coarse textured, and the subsoil has moderate permeability. This soil is underlain by gravel at a depth of 20 to 36 inches. It is moderately to strongly saline. The water table is at a depth of 1 to 3 feet during the growing season.

This soil is easy to work. It is somewhat droughty if drained because of the limited depth. The available water holding capacity is low, and because of salinity, water is not readily available to many cultivated crops. The water-intake rate is moderately rapid. Surface runoff is slow, and the hazard of erosion is slight.

This soil is used for all crops adapted to the Alamosa Area. In undrained areas, growth of potatoes, vegetables, and alfalfa is reduced. Small grains may be affected by salt and the high water table. This soil needs drainage and leaching. Irrigations should be light and frequent, however, except when water is used for leaching. Suitable irrigation methods are border and furrow. Leveling helps to obtain more uniform application of water, but the soil should be leveled with caution to avoid cutting into gravel. Management of irrigation water is very important to prevent buildup of the water table and accumulation of salts. Such water- and salt-tolerant grasses as tall wheatgrass, alta fescue, and reed canarygrass in mixture with red clover or alsike clover are productive for pasture and hay. Applications of fertilizer should be based on results of soil tests.

Capability Unit IIIs-3

McGinty sandy loam is the only soil in this unit. This soil is well drained and nearly level. It occurs on low terraces and flood plains. The surface layer is moderately coarse textured, and the subsoil has moderately rapid permeability. This soil is underlain by sand at a depth of 40 to 60 inches.

This soil is easy to work. Soil blowing is a slight to moderate hazard if the soil is not protected. The available water holding capacity is moderate. The water-intake rate is moderately rapid. Surface runoff is slow.

This soil is suited to irrigated crops, pasture, and hay and to all adapted crops and cropping sequences. Suitable irrigation methods include furrows and borders with shortened runs, as well as sprinklers (pl. V, top left). Subirrigation is used in some areas. Leveling helps to improve management of irrigation water. Stubble and other crop residues can be kept on the surface to control soil blowing. Emergency listing may be needed if blowing starts. Legumes grown on this soil respond to applications of phosphorus, and nonlegumes respond to nitrogen and phosphorus. All adapted grasses and legumes are suitable for pasture or hay, including smooth brome, orchardgrass, intermediate wheatgrass, alfalfa, red clover, and alsike clover.

Capability Unit IIIsw-3

McGinty sandy loam, saline, is the only soil in this unit. This soil is poorly drained and nearly level. It occurs on flood plains. The surface layer is moderately coarse textured, and the subsoil has moderately rapid permeability. A fluctuating water table resulting from seepage is at a depth of 2 to 4 feet. This soil is slightly to moderately saline.

This soil is easy to work. It has moderate to low available water holding capacity. Salinity makes much of the stored water unavailable to cultivated crops. The water-intake rate is moderately rapid.

Natural fertility is low to medium. Surface runoff is slow, and the hazard of erosion is slight.

This soil is used for all adapted crops, although the growth of grain may be uneven and yields of all crops are reduced because of salts and the fluctuating water table. Potentially, however, this is a good soil for crops if it is drained and leached. Without adequate drainage, a grass such as alta fescue, reed canarygrass, or tall wheatgrass in mixture with red clover, alsike clover, or sweetclover is good for pasture or hay.

This soil needs drainage and leaching to improve crop production. Management of irrigation is essential. Short irrigation runs and limited amounts of water help to prevent waterlogging and buildup of salt. Leveling helps in the management of irrigation water. This soil generally can be economically drained and leached. If this is done and if the soil is leveled and fertilized, it is quite productive. Legumes respond to applications of phosphorus, and nonlegumes respond to nitrogen and phosphorus. Measures that control soil blowing, such as keeping stubble on the surface, are a necessary part of conservation. Emergency listing can be used if the soil starts to blow.

Capability Unit IIIsw-4

San Luis sandy loam, drained, is the only soil in this unit. This soil is moderately shallow, somewhat poorly drained, and nearly level. It occurs on flood plains in the western part of the survey area. The surface layer is moderately coarse textured, and the subsoil has moderately slow permeability. This soil is underlain by sand at a depth of 24 to 40 inches. The water table is at a depth of 3 to 6 feet. The soil is slightly saline and is moderately affected by alkali.

This soil is easy to work. It has high available water holding capacity. The water-intake rate is moderately rapid. Surface runoff is slow, and the hazard of erosion is moderate.

This soil is suited to all adapted irrigated crops and sequences, and all crops are grown on it.

The soil has been drained and leached; however, drainage must be maintained to prevent seepage and salt accumulation. Suitable irrigation methods are furrow, border, and sprinkler. Some small areas are subirrigated. Runs generally need to be short and only limited amounts of water applied to prevent seepage and salt accumulation. Leveling helps in the management of irrigation water. Fall irrigation may be desirable on alfalfa to lessen winter kill. Crop residues can be kept on the surface to protect the soil from blowing in spring. Emergency listing may be needed if the soil starts to blow. Legumes grown on this soil respond to applications of phosphorus, and nonlegumes respond to nitrogen and phosphorus. Smooth brome, orchardgrass, timothy, and intermediate wheatgrass are good grasses for hay and pasture. Alfalfa, red clover, and alsike clover are adapted legumes.

Capability Unit IIIsw-5

San Luis sandy loam is the only soil in this unit. This soil is poorly drained and nearly level. It occurs on flood plains in the western part of the survey area. The surface layer is moderately coarse textured, and the subsoil has moderately slow permeability. This soil is underlain by sand at a depth of 24 to 40 inches. It has a high water table at a depth of 1 to 3 feet. It is moderately to strongly saline and alkali.

This soil is easy to work. The available water holding capacity is high, but water is not readily available to many cultivated crops, because of the salinity and alkali. The water-intake rate is moderately rapid. Surface runoff is slow, and the hazard of erosion is slight.

Small grains and alfalfa are the main crops grown. Potatoes are grown to a minor extent. If drained and leached, this soil is potentially suited to any crop adapted to the survey area. All crops are affected by the high salt content and the water table

This soil needs improved drainage and leaching. A soil amendment, such as gypsum or sulfuric acid, is needed to leach the soil adequately. Suitable irrigation methods are furrow, border, and sprinkler. Irrigation runs ought to be short and only a small amount of water applied to lessen buildup of the water table, excess salts, and alkali. Applications of nitrogen and phosphorus should be based on results of soil tests. For pasture and hay, such water- and salt-tolerant grasses as tall wheatgrass, alta fescue, reed canarygrass, and Russian wildrye are suitable. Red clover, sweetclover, and alsike clover are suitable legumes.

Capability Unit IIIw-1

In this unit are soils of the Alamosa, Arena, Homelake, and Vastine series and Loamy alluvial land. These soils are poorly drained and somewhat poorly drained and are nearly level. They are on flood plains near the Rio Grande River and major creeks. The surface layer is moderately fine textured to medium textured, and the subsoil has moderate to moderately slow permeability. The soils are underlain by sand at a depth of 24 inches to more than 60 inches. The water table may rise to within 1 to 2 feet of the surface in spring.

These soils are moderately difficult to work. They have moderate to high available water holding capacity. The water-intake rate is moderate to slow. Surface runoff is slow, and the hazard of erosion is slight.

These soils are used for alfalfa, small grains, and meadow hay. Vegetable crops are grown in some localities. Potatoes do not grow well on these soils, because of inadequate drainage and unfavorable soil texture. Alfalfa and small grains may be damaged in years when the water table is high.

Suitable irrigation methods are furrow, border, and contour ditch. Leveling helps in the management

of irrigation water. Runs can be longer on these soils than on more sandy soils, but the amount of water applied, and the length of time it is applied, need to be reduced to keep down seepage and salt accumulation. Maintenance of fertility and good tilth is important. Nonlegumes grown on this soil respond to applications of nitrogen and phosphorus, and legumes respond to phosphorus. These soils are difficult to drain, although drainage generally is necessary for good growth of crops. Outlets for drains generally are not available.

If used for pasture and hay, these soils are suited to most adapted grasses, such as smooth brome, timothy, intermediate wheatgrass, and alta fescue. Sweetclover, red clover, and alsike clover are suitable legumes.

Capability Unit IIIw-2

In this unit are soils of the Alamosa and Nortonville series and Wet alluvial land. These soils are somewhat poorly drained and poorly drained and are nearly level. They occur on flood plains near the Rio Grande River and the major creeks. The surface layer is moderately fine textured to medium textured, and the subsoil has moderately slow permeability. These soils are underlain by sand at a depth of 24 inches to more than 60 inches. They have a water table at a depth of 1 to 2 feet during much of the growing season, and this interferes with the growth of most crops except meadow grasses. The soils also have moderate to strong salinity.

These soils are moderately difficult to work. They have moderate to high available water holding capacity. Surface runoff is slow. The water-intake rate is moderate to slow, and the hazard of erosion is slight.

The main crops grown are small grains, alfalfa, and meadow hay. These soils are not suited to potatoes or other vegetables. Alfalfa and small grains are affected by salts and the water table.

Suitable irrigation methods are border, contour ditch, and furrow. Leveling and good management of irrigation water are necessary to leach out salts. Deep cuts in leveling may expose gravel bars in places. Overirrigation adds to the buildup of salts and the water table. Improved drainage and leaching are needed; however, drainage is difficult because the soils are in low areas where outlets generally are not available. Maintenance of fertility and good tilth is important. If used for pasture and hay, these soils are suited to salt- and water-tolerant species. Tall wheatgrass, alta fescue, reed canarygrass, Russian wildrye, sweetclover, red clover, and alsike clover are suitable.

Capability Unit IVe-1

In this unit are soils of the Costilla, Gunbarrel, and Space City series. These soils are somewhat poorly drained to somewhat excessively drained and are nearly level. They occur on flood plains. The surface layer and subsoil are coarse textured, and the subsoil has rapid permeability. The soils are underlain by sand and gravel at a depth of 24 to 60 inches.

These soils are easy to work. Their available water holding capacity is low to very low, and the soils are very droughty. The water-intake rate is rapid. Surface runoff is very slow. The hazard of soil blowing is very severe if the plant cover is not adequate.

These soils are used for potatoes, small grains, alfalfa, and vegetables (pl. V, top right). Most adapted crops can be grown, but droughtiness and the danger of soil blowing limit the kinds of cropping sequences that are suitable. The Gunbarrel soils are the most important potato-producing soils in the survey area.

Growing high-residue crops three-fourths of the time helps to control soil blowing. Suitable irrigation methods include furrows and borders with extremely short runs, as well as sprinklers (pl. V, bottom left). Gunbarrel loamy sand is well suited to subirrigation, and much of it is irrigated by this method. Costilla loamy sand is not suited to subirrigation.

Fertilization is very important. Nonlegumes grown on these soils respond to applications of nitrogen and phosphorus, and legumes respond to phosphorus. Leveling helps in the application of water. Residues left standing through the windy season or cover crops established following low-residue crops reduce soil blowing. Chiseling or subsoiling may be necessary in some places to break up a compacted layer. Drought-resistant grasses and legumes are suitable for pasture and hay plantings. Smooth brome, intermediate wheatgrass, Russian wildrye, alfalfa, and sweetclover are adapted species.

Capability Unit IVew-1

Gunbarrel loamy sand, saline, is the only soil in this unit. This soil is somewhat poorly drained and nearly level. It occurs on flood plains in the western part of the survey area. The surface layer is coarse textured, and the subsoil has rapid permeability. Sand and gravel occur at a depth of 24 to 60 inches. This soil is moderately to strongly affected by salts and alkali. The water table is only 1 to 3 feet below the surface during a large part of the year and interferes with the growth of cultivated crops.

This soil is easy to work. The available water holding capacity is low to very low, and water is not readily available to many crops, because of the salinity and alkali. The water-intake rate is rapid, and surface runoff is slow. The hazard of soil blowing is severe if the surface is not adequately covered.

This soil is suited to pasture, although most crops adapted to the survey area are grown. Crop growth generally is reduced because of the salt. Small grains may be affected by salt and the water table.

Drainage and leaching are needed. In areas where outlets are available, this soil can be easily drained and leached, but unless the water table can be controlled, the soil is droughty. Adapted methods of irrigation are sprinklers, as well as furrows and borders with short irrigation runs. Some small areas are subirrigated, but the water table is difficult to control. Leveling helps to get more uniform water application. Residues left on the surface help to control soil blowing. A cover crop is needed if the soil is bare. Emergency listing may be needed in spring to reduce soil blowing. Water- and salt-tolerant plants are suitable for hay or pasture plantings. Tall wheatgrass and sweetclover are well suited to these conditions. If surface salts can be sufficiently diluted, alta fescue, Russian wildrye, and several other species are adapted.

Capability Unit IVs-1

Hapney loam is the only soil in this unit. This soil is moderately well drained and nearly level. It has a moderately fine textured or fine textured subsoil that has slow permeability.

This soil is moderately difficult to manage because of alkali and the difficulty of getting good water penetration. The available water holding capacity is moderate. The water-intake rate is moderately slow. The hazard of erosion is slight to moderate.

This soil is suited to and is used for irrigated pasture, small grains, and alfalfa. It is not suited to potatoes. It has a potential for growing other vegetable crops.

Leveling helps to improve water application. Adequate drainage must be maintained, but this is not too difficult in areas where outlets can be established. Gypsum or sulfuric acid can be used to help leach alkali out of the soil. This soil can be tilled only within a narrow range of moisture content. Maintenance of fertility and good tilth are important. Nonlegumes respond to applications of nitrogen and phosphorus, and legumes respond to phosphorus. For irrigated pasture, grasses adapted to alkali soils do well. These include tall wheatgrass, Russian wildrye, and reed canarygrass. Sweetclover and alsike clover also are suitable for irrigated pasture.

Capability Unit IVsw-1

LaSauses sandy clay loam is the only soil in this unit. This soil is poorly drained and nearly level. The surface layer is moderately fine textured, and the subsoil and substratum are fine textured and have very slow permeability. This soil is strongly saline and alkali. The water table is high.

This soil is moderately difficult to work and very difficult to manage. The available water holding capacity is moderate, although most cultivated crops cannot obtain sufficient water because of salts. The water-intake rate is slow. Surface runoff is medium, and the hazard of erosion is slight.

In its present condition, this soil is better suited to meadow grasses than to most other plants. Small grains are grown in some places and produce a fair growth if drainage and leaching are accomplished. Potatoes and other vegetables are not suited.

This soil needs improved drainage, leaching, and deep chiseling or subsoiling for production of irrigated crops. It is very difficult to drain and leach. Leveling is needed for more nearly uniform distribution of water. Border and furrow irrigation methods are suitable. If this soil is used for pasture and hay, salt- and water-tolerant species should be used. These include tall wheatgrass, Russian wildrye, and sweetclover. Such other water-tolerant species as reed canarygrass may be suitable if the salts in the surface layer can be diluted enough while the plants are being established.

Capability Unit IVs-2

In this unit are soils of the Graypoint-Gravelly land complex, 0 to 2 percent slopes, the San Luis-Gravelly land complex, and Sandy alluvial land. These soils are poorly drained and nearly level. The surface layer is moderately coarse textured to coarse textured, and the subsoil has moderate permeability. In many places the surface layer is underlain by gravel that has very rapid permeability. Gravel occurs within a depth of 9 to 15 inches over most of the acreage, although the San Luis soil is deeper. Sandy alluvial land is included in this unit because of its similarity to the other soils and its limited use for irrigation.

These soils are easy to work but are very difficult to manage because of severe droughtiness. Available water holding capacity generally is very low, although the San Luis soil has high available water holding capacity. The water-intake rate is moderately rapid to rapid. Surface runoff is very slow, and the hazard of erosion is slight.

The soils in this unit are used for alfalfa, potatoes, and small grains. Growing a legume or a small grain in the crop sequence at least half the time helps to maintain good tilth and productivity. Suitable irrigation methods are border, furrow, contour ditch, and sprinkler. If lengths of runs are short and large heads of water are used, water waste and nutrient leaching can be reduced. Crops grown on these soils respond to applications of fertilizer. Phosphorus should be applied to legumes, and nitrogen and phosphorus to nonlegumes. Use of residues and green manure may increase the water- and nutrient-holding capacity of the soils. Extreme care should be taken in leveling to avoid deep cuts that expose large areas of gravel bars. If leveling is to be satisfactory, some areas may have to be undercut and backfilled.

If these soils are used for pasture and hay, such drought-resistant plants as smooth brome, intermediate wheatgrass, sweetclover, and alfalfa are adapted.

Capability Unit IVw-1

In this unit are soils of the LaJara and Medano series. These soils are poorly drained and nearly level. They occur on flood plains of Alamosa, LaJara, and Big Spring Creeks. The surface layer is medium textured to moderately coarse textured, and the subsoil or underlying layer has moderate to rapid permeability. These soils have a substratum of sand. The water table commonly is high, at a depth of about 1 to 2 feet during spring and summer.

These soils are easy to work but are difficult to manage because of the limited time they can be worked during spring. Available water holding capacity is low to high. The water intake rate is moderate to moderately rapid. Surface runoff is slow, and the hazard of erosion is slight.

Crops normally grown are small grains, alfalfa, and meadow hay. The soils are not suited to potatoes or other vegetables. They are too wet for any cultivated crop that needs tillage during summer. Alfalfa and small grains may be affected by the high water table.

Irrigation generally is by the contour ditch, border, or corrugation method. Most meadowland is irrigated by flooding. In this method, water is diverted from a ditch or stream and is allowed to follow the low ground. This normally is done in spring when the creeks are high and water is plentiful. Leveling helps to obtain better management of irrigation water. Drainage generally is not practical, because outlets are not available. Nonlegumes grown on these soils respond to applications of nitrogen and phosphorus, and legumes respond to phosphorus. Water-loving plants are suitable for pasture and hay plantings. Meadow foxtail, timothy, reed canarygrass, sweetclover, red clover, alsike clover, and strawberry clover are suitable grasses and legumes.

Capability Unit Vw-1

In this unit are soils of the Alamosa, Homelake, LaJara, Medano, and Vastine series. Also in the unit are Loamy alluvial land and Peat. These soils are somewhat poorly drained to poorly drained. They occur along bottom lands of the Rio Grande River and Alamosa and LaJara Creeks. The surface layer is moderately coarse textured to moderately fine textured, and the subsoil has moderately slow to rapid permeability. Some areas are underlain by sand at a depth of 24 to 60 inches. These soils have a water table within 1 to 3 feet of the surface much of the time in spring and summer.

These soils have moderate to high available water holding capacity. The high water table is beneficial to meadow grasses. These soils are subject to flooding in spring. Surface runoff is slow, and the hazard of erosion is slight.

Soils in this unit are suited to pasture, hay, or range. For pasture and hay, plants are needed that can grow in wet soil but also are drought resistant to some degree. Alta fescue, timothy, slender wheatgrass, sweetclover, red clover, and alsike clover are suitable. Reed canarygrass and meadow foxtail are especially well suited to the wetter areas and also do well in drier places. Bromegrass is suited to some of the drier areas. Selected areas may be profitably fertilized with nitrogen to increase production. These soils are in the Wet Meadow range site. Nebraska sedge, tufted hairgrass, bluejoint reedgrass, and slender wheatgrass are native to this site.

Capability Unit VIs-1

Hooper loamy sand is the only soil in this unit. This soil is strongly alkaline and nearly level. The surface layer is coarse textured, and the subsoil is fine textured and has very slow permeability. The soil is underlain by sand and gravel at a depth of 20 to 40 inches.

The available water holding capacity is low. The water-intake rate is only moderate because of the high content of sodium. Surface runoff is slow, and the hazard of soil blowing is slight to moderate.

This soil is used for irrigated meadow and irrigated pasture. It is not suitable for crops. The vegetation consists of alkali sacaton, alkali cordgrass, sedges, rushes, and saltgrass. Alkali-tolerant grasses suitable for planting are tall wheatgrass and Russian wildrye.

This soil is irrigated by flooding. Land smoothing improves water application.

Capability Unit VIw-1

In this unit are soils of the Alamosa and Nortonville series and Wet alluvial land. These soils are somewhat poorly drained to poorly drained and are nearly level. They occur along the Rio Grande River and Alamosa and LaJara Creeks. Many old channels and oxbows occur. The surface layer is medium textured to moderately fine textured, and the subsoil has moderate to moderately slow permeability. The soils have a high water table at a depth of 1 to 3 feet during much of the year, and this is beneficial to meadow grasses. Some areas also are subject to flooding in spring. These soils are slightly to strongly saline.

The available water holding capacity is moderate to high. The water-intake rate is moderate to slow. Surface runoff is slow, and the hazard of erosion is slight.

These soils are suited to pasture, hay, or range. Adapted pasture and hayland plants are those that are tolerant of excess water and salt. Tall wheatgrass, intermediate wheatgrass, slender wheatgrass, and redtop can be used. Red clover and alsike clover are adapted legumes. Reed canarygrass and meadow foxtail are adapted grasses for the wetter areas.

Some irrigation helps to get seedlings established. Selected areas that are not excessively salty can be fertilized with nitrogen to increase plant growth. Soils in this unit are in the Salt Meadow range site.

Alkali sacaton, slender wheatgrass, saltgrass, sedges, and rushes are native to this site.

Capability Unit VIw-2

In this unit are soils of the Acacio, Arena, Corlett, LaSauses, McGinty, Mosca, San Arcacio, San Luis, Villa Grove, and Zinzer series. These soils are nearly level on flood plains and gently sloping on terraces. They range widely in soil characteristics. They are moderately shallow over sand and gravel or are deep; their surface layer is coarse textured to moderately fine textured; and their subsoil ranges from moderately rapid to very slow in permeability. The soils are slightly to strongly saline, and they either have a water table or are wet at times during the year to a degree that promotes the growth of salt- and water-tolerant plants.

These soils have low to high available water holding capacity. Surface runoff is slow to medium. The hazard of soil blowing is slight to moderate if the vegetative cover is not adequate.

These soils are suited to range and pasture. They are used mostly as range that is grazed by sheep and cattle. The salt-tolerant plants are mostly alkali sacaton, inland saltgrass, greasewood, and rabbitbrush. These plants readily obtain water from the saline soils.

Proper use of the range helps to promote the growth of desirable plants. Fencing and stock-water development are practices that help to get better range use. Brush control and seeding may be needed in some areas to improve the plant cover. Brush may be eradicated by spraying or disking. Alkali sacaton is a suitable grass for seeding. Introduced grasses commonly seeded are tall wheatgrass and Russian wildrye. Irrigation by sprinkler or flooding normally is needed to get grass established.

Capability Unit VIIe-1

In this unit are soils of the Costilla and Space City series. These are somewhat excessively drained, sandy and gravelly soils that are nearly level to sloping. The surface layer is coarse textured and, in some areas, is gravelly. The subsoil and substratum have rapid permeability.

Available water holding capacity is low or very low. The water-intake rate is rapid, and surface runoff is very slow. The hazard of soil blowing is very severe if the vegetative cover is not adequate.

These soils are used primarily for range. Antelope graze these soils regularly, and deer also range over them. Proper use helps to promote the growth of desirable grasses. Proper use can be accomplished through fencing, stock-water development, and rotation grazing. Some areas need to be deferred from grazing to improve the range. Indian ricegrass may be suitable for seeding small areas where a grass cover is lacking or sparse, but the chances of getting a stand are slight because of very low rainfall. The vegetation on these soils consists of spiny muhly, Indian ricegrass, blue grama, low rabbitbrush, Greens rabbitbrush, and pricklypear.

Capability Unit VIIe-2

Cotopaxi sand, hilly, is the only soil in this unit. This soil is coarse textured and excessively drained. It occurs on undulating sand hills in the northeastern corner of the survey area.

The available water holding capacity is very low, although nearly all of the water stored is available to plants. Surface runoff is very slow. The hazard of soil blowing is very high if the ground cover is not adequate.

This soil is grazed mainly by cattle, but it is also used by antelope. Proper use helps to promote the growth of desirable range grasses. This can be accomplished by fencing and stock-water development. It may be necessary to exclude some areas from grazing for extended periods to allow the grass cover to improve. Because the soils are erodible and droughty, it is impossible to reseed them and get a stand. The vegetation is mostly Indian ricegrass and blowout grass. A few plants of little rabbitbrush occur.

Capability Unit VIIe-3

Corlett sand, hilly, is the only soil in this unit. This soil is coarse textured and very strongly alkali. It is in dunelike areas in the central and northern parts of the survey area. It has a coarse-textured surface layer and subsoil, and its permeability is rapid.

Available water holding capacity is low, and, because of the very strong alkali, the water stored is available only to salt-tolerant plants. The water-intake rate generally is only moderate, because of the high sodium content and the dispersed surface layer. Surface runoff is slow. The hazard of soil blowing is very severe if the vegetative cover is not adequate.

This soil is used mainly for grazing and is suited to this use. Good grazing management helps to promote the growth of desirable grasses. Such management includes deferred grazing, sometimes for extended periods, fencing, and stock-water development. It is impossible to reseed this soil and get a stand of grass because rainfall is so limited and the soil is so erodible. The vegetation is mainly alkali sacaton, inland saltgrass, and greasewood.

Capability Unit VIIe-4

In this unit are soils of the Gunbarrel, Hooper, Littlebear, Mosca, and Space City series. These soils are somewhat poorly drained to somewhat excessively drained, and nearly level to sloping. The surface layer is moderately coarse textured to coarse textured, and the subsoil has very slow to

rapid permeability. These soils contain alkali in the subsoil or substratum or have a water table that encourages the growth of greasewood.

The available water holding capacity is very low or moderately low in these soils. The water-intake rate is moderately rapid to rapid. Surface runoff is slow or very slow, and the hazard of erosion is very severe if the plant cover is inadequate.

These soils are used mainly for grazing by cattle and sheep. The vegetation is greasewood, rabbitbrush, alkali sacaton, saltgrass, blue grama, and spiny muhly.

Proper use of the range promotes the growth of desirable grasses. This may be accomplished by fencing and stock-water development. Stock water can be developed on these soils from artesian wells. In some places deferred grazing is necessary to improve grass stands. Where greasewood is dominant, it can be controlled by spraying. This practice is desirable in places where enough grass remains to use the additional moisture made available after the brush is killed. The dead brush should be left standing to help control soil blowing. Owing to the limited amount of rainfall and the very severe risk of erosion, it is impossible to reseed these soils and get a stand of grass without irrigation.

Capability Unit VIIs-1

Mount Home-Saguache cobbly sandy loams, 4 to 12 percent slopes, are in this unit. These soils are gravelly and cobbly and are sloping. They occur on alluvial fans at the foot of the mountains along the eastern edge of the survey area. The surface layer is moderately coarse textured, gravelly, and cobbly. Below this is gravelly and cobbly soil material that has rapid to moderately rapid permeability.

The available water holding capacity is very low in these soils, although most of the stored water is readily available to plants. The water-intake rate is moderately rapid or rapid. Surface runoff is slow, and the hazard of erosion is slight to moderate.

These soils are used mainly for range that is grazed by cattle and sheep. Deer and antelope also range over these soils. The vegetation includes blue grama, sand dropseed, Indian ricegrass, needle-and-thread, and other grasses. Shrubs include Apache-plume, four-wing saltbush, gooseberries, currants, and some pricklypear and yucca.

Good range management promotes the growth of desirable grasses. This can be accomplished by proper grazing, fencing, and water development. Reseeding is difficult except in selected areas that are not excessively cobbly, and the chance of getting a stand of grass by seeding is poor because of the limited moisture.

Capability Unit VIIs-2

Uracca very cobbly loam, 15 to 35 percent slopes, is the only soil in this unit. This soil is very cobbly and moderately steep. It occurs on alluvial fans of the mountains along the eastern edge of the survey area. The subsoil has moderate permeability. The content of cobblestones and stones increases with depth.

The available water holding capacity is very low because of the many cobblestones. Several streams that originate in the mountains above the fans disappear into this very cobbly soil. It is too cobbly for any practices that require machinery. Surface runoff is slow, and the hazard of erosion is slight, although there are many old gullies.

Pinyon pine, the major plant, produces more than half the annual yield of plant material. Small numbers of juniper trees are mixed with the pinyon pines. The potential for forage production is low and highly variable. Some north-facing slopes are capable of producing a moderate amount of forage, but many exposed south- and west-facing slopes have very limited potential. Among the most common grasses are Indian ricegrass, needle-and-thread, western wheatgrass, Scribner needlegrass, and blue grama. Mountain muhly does well on some of the north-facing slopes. Some brushy plants, such as four-wing saltbush, winterfat, and mountain-mahogany, provide forage for livestock. Mountain-mahogany is also a valuable browse plant for deer.

Where grazing has been heavy and continuous, the plant cover is mostly pinyon pine, along with smaller amounts of juniper and brushy plants. Under these conditions, much of the soil surface is bare, and there are only scattered grasses, mostly blue grama. There also is a marked increase in such worthless plants as pricklypear and pingue.

This soil is used for grazing, although grass production is limited because of the many cobblestones and the thick stand of pinyon trees. Some of the trees are used for firewood, and fenceposts can be cut from some areas. This soil is an important habitat for deer.

Capability Unit VIIs-3

In this unit are soils of the Acacio, Laney, McGinty, San Arcacio, Villa Grove, and Zinzer series. These soils are moderately well drained to well drained and are nearly level to gently sloping. They occur on flood plains and low terraces throughout the survey area. The surface layer is moderately coarse textured to moderately fine textured, and the subsoil has moderately slow to moderately rapid permeability. One of the soils is underlain by sand and gravel at a depth of 20 to 36 inches.

The available water holding capacity generally is high, but it is low in the San Arcacio soil. The water-intake rate is moderate to moderately rapid. The hazard of soil blowing is slight to moderate if a plant cover is not maintained. The vegetation consists of alkali sacaton, inland saltgrass, greasewood, and rabbitbrush.

These soils are used mostly for range that is grazed by sheep and cattle. Fencing and the development of stock water promote proper range use and the

growth of desirable grasses. Brush control is beneficial in some places where greasewood and rabbitbrush grow in stands thick enough to seriously compete with grasses and where enough grasses are present to benefit. This can be done by spraying and then leaving the dead brush as cover to control soil blowing. Because of low rainfall, it is very difficult to establish grass without irrigation.

Capability Unit VIIs-4

In this unit are soils of the Hooper series, the Graypoint-Gravelly land complex, 0 to 2 percent slopes, and the San Luis-Gravelly land complex. These soils are either too droughty or too alkali to support vegetation that is suitable for grazing management. They are nearly level and occur throughout the closed basin part of the survey area, as well as in a small area along Rock Creek in the southwestern part of the survey area. The San Luis-Gravelly land complex is placed in this unit because of its small acreage in range and the similarity of one of its components to other soils in the unit.

The available water holding capacity is very low to low because of shallowness and very strong alkali. The alkali soils are dispersed, and their water-intake rate is very slow. Rainwater stands on these soils until it evaporates. The other soil in this unit has a moderately rapid water-intake rate, moderate permeability in the subsoil, and very rapid permeability below the subsoil. Surface runoff is very slow, and the hazard of erosion is slight.

The soils of this unit are used for very limited grazing. Most of the forage is obtained from a thin stand of little rabbitbrush and greasewood. It is not practical to reseed these soils unless irrigation water can be used to establish the grass. Even with irrigation, one of the soils in the unit contains so much alkali that it will not absorb water.

Capability Unit VIIs-5

In this unit are soils of the Corlett and Hooper series. These soils are strongly alkali and nearly level to undulating. The surface layer is coarse textured, and the subsoil is fine textured to coarse textured. The subsoil has very slow to rapid permeability.

The available water holding capacity is low. The water-intake rate generally is only moderate because of the high content of sodium in these soils. Surface runoff is slow. The hazard of soil blowing is slight to moderate on the Hooper soils and very severe on the Corlett soils.

These soils are used for range. The vegetation is alkali sacaton, inland saltgrass, greasewood, and rabbitbrush. Deferred grazing and other practices of good management help to promote the growth of desirable grasses and to control soil blowing. Stock-water development and fencing help to improve the distribution of livestock. Stock water can be developed by installing artesian wells. Because of the limited amount of rainfall and the erodibility of the soils, reseeding is not practical unless irrigation water can be used in establishing the grass. The existing plant cover should not be destroyed.

Capability Unit VIIs-6

Hapney loam is the only soil in this unit. This soil is strongly alkali and nearly level. It occurs in the central part of the survey area. The surface layer is medium textured to moderately fine textured, and the subsoil has slow permeability.

The available water holding capacity is only moderate because of the alkali. The surface layer commonly is dispersed because of the high sodium percentage, which causes a moderately slow water-intake rate. Surface runoff is slow. The hazard of soil blowing is slight to moderate.

This soil is used mainly for range that is grazed by cattle and sheep. The vegetation consists of western wheatgrass, inland saltgrass, alkali sacaton, rabbitbrush, and greasewood. Range management practices that help to promote the growth of grasses are fencing and stock-water development to control grazing. Stock water can be developed by installing artesian wells. Brush control by spraying in some areas is beneficial where the brush is thick enough to seriously reduce grass production and where enough grass is present to use the extra moisture. Reseeding is not feasible on this soil without irrigation to get the grass started.

Capability Unit VIIw-1

Only Sandy alluvial land is in this unit. This land type consists of mixed alluvial soils along the Rio Grande River. These soils are subject to flooding during spring runoff, and they have a high water table when the river is high. They are excessively drained when the river is low. The surface layer is medium textured to coarse textured. It is underlain by sand and gravel at a depth of 8 to 20 inches. Many gravel bars occur.

The available water holding capacity is very low. The water-intake rate is medium to rapid. Surface runoff is slow, and the hazard of erosion is slight.

This land type is used mainly for grazing. The kind of vegetation is determined largely by the degree and frequency of flooding. Generally, there is a thick stand of cottonwood trees and willows and an understory of grasses (pl. V, bottom right). These plants provide good cover for wildlife, and they also provide considerable grazing for livestock.

Capability Unit VIIw-2

Hooper soils, occasionally flooded, are in this unit. These soils are poorly drained. They are in depressional areas, old lakebeds, and other places

that are flooded by overflow and runoff from surrounding areas. The surface layer is moderately fine textured to coarse textured, and the subsoil has very slow permeability. The soils are strongly saline and alkali and have a high water table.

The available water holding capacity is low because of the salinity and alkali, and water held in the soil can be used only by the most salt-tolerant plants. The water-intake rate is slow. Surface runoff is very slow, and water commonly stands on the surface for extended periods. The hazard of erosion is slight.

These soils are used mainly for grazing. In the areas where they occur, they commonly provide most of the grass for livestock.

Proper range use helps to promote the growth and vigor of desirable plants. This can be accomplished by rotation and deferred grazing, fencing, and stockwater development. Seeding is not practical, because of flooding and the strong salinity and alkali. The main plants are inland saltgrass and baltic rush. Alkali cordgrass grows in some places.

Capability Unit VIIIe-1

Only Dune land is in this unit. This land type is highly susceptible to soil blowing. There is no vegetation, and the sand shifts constantly with the wind. This land type is used only for esthetic and recreational purposes. Most of it is in a national monument.

Capability Unit VIIIw-1

Only Marsh is in this unit. This land type is in permanently wet areas near the Rio Grande River and major creeks. These areas are too low to be drained. The vegetation is mainly cattails, sedges, and rushes.

This land type is used only for wildife habitat. It provides good nesting and cover areas for ducks and provides good duck hunting. Only a limited amount of forage is available for grazing around the edges during the driest part of the year.

Capability Unit VIIIs-1

Comodore extremely rocky loam, 40 to 150 percent slopes, is the only soil in this unit. This soil is extremely steep and rocky. It occurs along the extreme eastern edge of the survey area. There are many outcrops of rock.

The vegetation is thin stands of spruce, pine, fir, and pinyon trees on north-facing slopes and pinyon and juniper trees on south-facing slopes. The principal grasses are mountain muhly and blue grama. There are many browse plants, including mountain-mahogany, currant, and gooseberry.

This soil generally is too steep for livestock to graze. It is an important habitat for deer and provides good cover and food.

Predicted Yields of Principal Irrigated Crops

Predicted average acre yields of the principal irrigated crops grown in the Alamosa Area are given in table 2. Yield predictions are made for two defined levels of management. Yields in columns A are those that can be expected under the prevailing level of management followed in the survey area. Yields in columns B are those that can be expected under a high level of management. Soils not listed in the table are not commonly used for irrigated crops.

The yield predictions are based on statistics of the Colorado Crop and Livestock Reporting Service; on observations made by the field party during the survey; on information obtained from farmers, agricultural specialists from various governmental agencies, and members of the staff of Colorado State University; and on records kept by farmers.

Management level "A" is the level of management followed by most farmers in the survey area. On most farms, one or more of the following practices are needed to bring average yields up to those in columns A: improved water application by land leveling; rearrangement of irrigation ditches or shorter irrigation runs; more use of barnyard manure, green-manure crops, and fertilizer; drainage and leaching of seeped saline areas; better weed and insect control; and better seed selection.

Management level "B" is a high level of management followed by only a few farmers in the survey area. This is the level of management to strive for to obtain the highest returns, to control erosion and prevent soil deterioration, and to make the most efficient use of water, labor, and equipment. This management includes improved water application by land leveling, proper length of runs, and use of concrete ditches and structures; use of barnyard manure and green-manure crops to maintain organic-matter content and fertility and improve tilth; use of fertilizers; providing adequate drainage and leaching where needed; weed control; seed selection; insect and rodent control; and deep chiseling or subsoiling where needed to break up a plowpan.

Many factors besides management affect crop yields, and an accurate prediction of yields is difficult to make. Therefore, the yield predictions given in table 2 should be used only as a guide in planning farming operations. Among the other factors that influence crop yields are the amount and timeliness of rainfall, the extent and severity of wind and hailstorms, the amount of moisture in the soil at planting time, the occurrence of damaging frost, and the amount of water available for irrigation.

Use and Management of Rangeland [2/]

This section deals with nonirrigated, nonforested soils on which domestic livestock graze primarily on

[2/] By T. E. MULLINGS, range conservationist, Soil Conservation Service, Durango, Colorado.

TABLE 2.--PREDICTED YIELDS OF PRINCIPAL IRRIGATED CROPS UNDER TWO LEVELS OF MANAGEMENT

[Yields in columns A are those obtained under common management; yields in columns B are those obtained under high-level management. Dashes indicate that the soil is not suited to the particular crop or that the crop is not normally grown on the soil]

Soil	Alfalfa		Potatoes		Barley		Oats		Lettuce		Irrigated pasture or meadow hay	
	A	B	A	B	A	B	A	B	A	B	A	B
	Tons	Tons	Cwt.	Cwt.	Bu.	Bu.	Bu.	Bu.	Crates	Crates	Tons	Tons
Acacio loam, 0 to 1 percent slopes	2.0	3.0	150	250	40	80	50	90	350	550	1.0	1.3
Acacio loam, 1 to 3 percent slopes	1.0	2.0	75	150	25	50	25	50	---	---	1.0	1.3
Acacio loam, saline, 0 to 1 percent slopes	1.5	2.5	100	200	30	60	30	55	250	400	.7	1.0
Alamosa loam	1.5	2.5	---	---	40	70	45	75	250	400	.8	1.1
Alamosa loam, saline	1.0	2.0	---	---	30	60	30	55	---	---	.5	.8
Arena loam	.75	1.5	---	---	25	40	25	40	---	---	.8	1.0
Arena loam, drained	1.5	2.5	---	---	40	70	45	75	300	450	1.0	1.3
Costilla loamy sand, 0 to 2 percent slopes	.5	1.0	100	200	25	50	30	55	---	---	---	---
Graypoint-Gravelly land complex, 0 to 2 percent slopes	.3	.5	50	100	15	25	15	25	---	---	.7	1.0
Gunbarrel loamy sand	1.5	2.0	200	350	30	60	35	65	400	600	.7	1.0
Gunbarrel loamy sand, saline	1.0	1.5	100	150	25	50	25	50	250	400	.6	.8
Hapney loam	1.0	1.5	---	---	35	60	35	60	---	---	.5	.8
Homelake loam	1.0	1.5	---	---	35	65	40	75	400	600	.6	1.5
Hooper loamy sand	---	---	---	---	--	--	--	--	---	---	.5	.7
LaJara loam	1.2	1.7	---	---	40	70	45	75	---	---	1.1	1.5
Laney loam	2.0	2.5	---	---	25	40	25	40	---	---	.7	1.2
LaSauses sandy clay loam	.75	1.25	---	---	20	40	20	40	---	---	.5	.7
Loamy alluvial land	1.5	2.0	---	---	40	70	45	75	250	400	.8	1.1
McGinty sandy loam	1.5	3.0	200	350	55	85	60	90	400	600	1.2	1.7
McGinty sandy loam, saline	1.0	2.0	125	250	35	55	35	55	300	450	1.0	1.5
Medano fine sandy loam	1.0	1.5	---	---	50	80	60	90	---	---	1.2	1.7
Mosca loamy sand	1.5	2.5	175	275	35	60	40	70	400	600	1.1	1.5
Mosca loamy sand, wet	1.0	1.5	100	200	25	50	25	50	---	---	.8	1.0
Nortonville loam	2.0	2.5	---	---	30	50	30	50	---	---	.7	1.2
San Arcacio sandy loam	2.0	3.0	175	300	50	80	60	90	350	550	.8	1.1
San Arcacio sandy loam, saline	1.0	1.5	75	125	30	60	30	50	200	350	.7	1.0
Sandy alluvial land	.5	1.0	---	---	--	--	--	--	---	---	.3	.6
San Luis sandy loam	.75	1.25	75	125	25	50	25	45	---	---	.6	.9
San Luis sandy loam, drained	1.75	2.5	150	250	40	70	45	75	300	450	1.2	1.7
San Luis-Corlett complex, undulating	---	---	---	---	--	--	--	--	---	---	.5	.7
San Luis-Gravelly land complex	1.5	2.0	125	225	30	55	35	60	---	---	.9	1.1
Space City loamy fine sand, 0 to 3 percent slopes	1.0	1.5	100	200	25	50	30	55	---	---	---	---
Space City loamy fine sand, alkali substratum, 0 to 3 percent slopes	1.0	1.5	---	---	---	--	--	--	---	---	---	---
Vastine loam	1.0	1.5	---	---	50	80	60	90	---	---	1.5	2.6
Villa Grove sandy loam, 0 to 1 percent slopes	2.5	3.0	150	250	40	70	50	80	300	500	1.2	1.7
Villa Grove sandy clay loam, saline, 0 to 1 percent slopes	1.0	1.5	75	125	30	50	30	50	200	350	1.0	1.3
Villa Grove sandy clay loam, saline, 1 to 3 percent slopes	1.0	1.5	---	---	25	50	25	45	---	---	1.0	1.3
Wet alluvial land	1.0	1.5	---	---	30	60	30	60	---	---	.5	.8
Zinzer loam, 0 to 1 percent slopes	2.5	3.5	175	275	50	80	60	90	350	550	1.2	1.7
Zinzer loam, 1 to 3 percent slopes	2.0	3.0	---	---	40	60	45	70	---	---	1.1	1.5
Zinzer loam, saline, 0 to 1 percent slopes	1.0	1.5	75	125	30	50	80	50	250	400	1.0	1.3

native plants. Such soils make up more than half of the Alamosa Area. Most of this acreage is better suited to range than to other uses. Native forage plants are thus an important resource, even though production generally is limited by the dry climate (3, 4).

Range and related areas used for grazing in the Alamosa Area occur in three general positions:

1. Soils on the valley floor that are affected to some degree by a water table and excess salts and alkali. On these soils there are sizeable blocks of rangeland and a number of small tracts scattered among irrigated areas. The potential for range use is highly variable. Some soils are capable of high forage production; others have very low value for grazing. Soils that have no consistent potential for producing forage plants (Hooper clay loam, Graypoint-Gravelly land complex, and Sandy alluvial land) are not covered in this section.
2. Broad, well-drained, sandy fans immediately below the mountains. Most areas of these fans are used for range and are well suited to this use.
3. Rough, mountainous land having shallow, stony soils along the eastern edge of the survey area. Nearly all the acreage of these soils is grazed to some extent by livestock, but much of it has limited grazing value because of steep slopes, extremely stony soils, and dense stands of pinyon pine. Grazing use of such land is discussed in the description of capability unit VIIs-2.

Range Sites and Range Condition

This soil survey can furnish valuable information as to the potential of soils for producing native plants, even though the original vegetation has been drastically changed. The kind of soil determines to a large degree the combination of plants that grow in an area and the yields that can be expected. Knowledge of the native plant potential of each soil helps an operator to manage his range in a way that favors the best forage plants for his particular set of conditions. For use in range management, therefore, soils that have similar potentials are grouped into range sites.

A range site is a distinctive kind of rangeland that has a certain potential for producing native plants. Each range site has the ability to develop a particular combination of plants found on no other site. This potential plant community, once established, maintains itself indefinitely unless altered by such outside factors as overgrazing, plowing, or repeated fires. So long as these alterations do not change the basic relationship of soil and moisture to plant growth, the potential plant community will ultimately return if given the chance.

Permanent changes in the environment may change the plant community, however. For example, the available moisture holding capacity and fertility of a soil may be altered by erosion or there may be a permanent change in the level of underground water or the occurrence or natural overflow. In such cases a new range site must be recognized.

Distinctions between range sites are recognized by differences in the kinds or proportions of plants that make up the potential plant community or differences in the total production of vegetation if the composition of the potential plant community is essentially the same. To be useful in conservation planning, the differences in the kind or amount of vegetation must be great enough to require some difference in management, such as a different rate of stocking.

Once the range site is known, range condition can be determined by comparing the present vegetation to the potential plant community. This provides an approximate measure of any deterioration that has taken place and, thereby, a basis for predicting the degree of improvement possible.

Decreasers are species in the potential plant community that decrease in relative abundance under continued moderately heavy to heavy grazing.

Increasers are species in the potential plant community that normally increase in abundance as the decreasers decline. They do not always react in this simple fashion, however. Plants that increase at first may subsequently decrease as moderately heavy to heavy use is continued. The forage value of increasers varies from high to low. Under continued close grazing, plants having a low value as forage tend to increase more rapidly than those having a high value.

If grazing continues to be heavy, the increasers eventually are replaced by plants that do not grow naturally on the specific site. These plants are called invaders.

Range condition expresses the present kind and amount of vegetation in relation to the potential plant community for a given site. Four classes are used to indicate the degree of departure from the potential plant cover brought about by grazing or other use. These classes show the present condition of the plant community on a range site in relation to the potential plant community that could grow there.

A range is in excellent condition if 76 to 100 percent of the vegetation is of the same kind as the potential plant community. It is in good condition if the percentage is between 51 and 75 percent, in fair condition if the percentage is between 26 and 50 percent, and in poor condition if the percentage is less than 25.

Assistance in determining range condition can be obtained from the local office of the Soil Conservation Service.

Descriptions of Range Sites

The nine range sites recognized in this survey area are discussed on the following pages.

Range practices are mentioned only where they apply specifically to the site under discussion. Practices that apply to range in general are not discussed in this section.

Wet Meadow Range Site

This originally was an important range site, but most of the acreage is now used for irrigated hay meadow. Although much of the site still produces native plants, its potential varies according to the effect of irrigation. The site occupies low areas next to streambeds. Originally, it was most extensive south of Alamosa, where Rock, Alamosa, and LaJara Creeks join the Rio Grande River.

The soils in this site are in the Alamosa, Homelake, LaJara, Littlebear, Medano, and Vastine series and Loamy alluvial land. These soils are very dark colored loams, clay loams, and fine sandy loams. They are free of salts and alkali except for a few small spots. Plant growth is strongly influenced by the high water table. These soils are normally wet in spring and early in summer, but they are dry on the surface by midsummer. Natural flooding may occur during years when runoff is normal or higher.

In the climax (potential) plant community, tufted hairgrass and Nebraska sedge are the most common decreasers, each making up about 20 percent of the vegetation. Other decreasers are bluejoint reedgrass, northern reedgrass, and alkali sacaton. Among the other plants are slender wheatgrass and western wheatgrass, which together make up about 20 percent of the stand, and wirerush, mat muhly, sedges other than Nebraska sedge, and perennial forbs.

The potential plant community in the wettest areas is made up of moisture-loving grasses and grasslike plants, such as tufted hairgrass, Nebraska sedge, bluejoint reedgrass, and northern reedgrass. Slender wheatgrass is prominent in slightly drier areas, where it is mixed with western wheatgrass. The latter may increase initially, but its high forage value compared to other increasers causes it to become scarce under prolonged heavy use. Alkali sacaton is conspicuous in a few high spots, but it is entirely absent in some places. Typical cover where the site is in poor condition is a mixture of wirerush, short sedges, mat muhly, and foxtail barley.

Artesian wells to improve livestock distribution can be developed wherever this site occurs within the survey area.

The estimated annual yield of air-dry plant material is 2,000 to 3,000 pounds per acre. About 1,800 to 2,700 of this provides grazing for cattle.

Salt Meadow Range Site

This site is mostly in low areas near the main streams in the survey area. In some places it forms a band between the Wet Meadow range site and drier soils. The soils in this site are of the Alamosa and Nortonville series and Wet alluvial land. These soils are dark-colored loams or sandy loams. The main factors that affect plant growth are a high water table, generally within a depth of 3 feet, and a slight to moderate effect from salts and alkali. Natural flooding may occur during times when runoff is normal or higher.

In the climax (potential) plant community, alkali sacaton is the most common decreaser, making up about 50 percent of the vegetation. Other decreasers are alkali cordgrass, slender wheatgrass, and creeping wildrye. Among the other plants are western wheatgrass, saltgrass, and wirerush, which together make up about 20 percent of the stand, and nuttall alkaligrass, sedges, and perennial forbs.

This approximate composition is variable, and alkali sacaton forms a nearly pure stand in many places. Alkali cordgrass or western wheatgrass is abundant in some areas but is scarce in others.

Western wheatgrass may increase initially under heavy grazing, but it becomes scarce if such use is prolonged. Plants that generally are prominent if the site is in poor condition include saltgrass, short sedges, wirerush, and foxtail barley. Saltgrass makes up most of the vegetation in some areas.

Artesian wells to improve livestock distribution can be developed wherever this site occurs within the survey area. In a few places greasewood has increased to the point where control is needed and is feasible.

The estimated annual yield of air-dry plant material is 1,500 to 2,500 pounds per acre. About 1,350 to 2,250 of this provides grazing for cattle.

Alkali Overflow Range Site

This site is mostly in the area of San Luis Lake and Dry Lakes, northeast of Alamosa. It occupies shallow lake basins and broad drainage courses that have no outlets. The only soils in this site are the Hooper soils, occasionally flooded. They are subject to overflow, but there may be long periods when no runoff is received. The water table is within 3 feet of the surface. The soils typically are wet and are strongly saline and alkali. Water moves through them very slowly, and this results in ponding after the infrequent floods. Plants that survive on the site are those that are tolerant of ponding and strong concentrations of salts and alkali. Such plants are able to maintain a fairly uniform stand most of the time (pl. VI, top left).

In the climax (potential) plant community, creeping wildrye is the most common decreaser, making up about 15 percent of the vegetation. Nuttall alkali grass, also a decreaser, makes up about 10 percent of the stand. Among the other plants are saltgrass, which makes up about 50 percent of the stand, wirerush, spikerush, and other plants.

The present vegetation is primarily saltgrass, along with wirerush and spikerush in the wettest spots. An occasional greasewood plant grows in the driest places, and there are a few other plants that are typical of areas where the concentration of salts is strong. Saltgrass, an increaser, persists

under heavy grazing, but the plants become weakened and the stand thinner under these conditions.

The estimated annual yield of air-dry plant material is 900 to 1,500 pounds per acre. About 800 to 1,350 of this provides grazing for cattle.

Salt Flats Range Site

This is the most extensive range site in the Alamosa Area. It is present throughout the main valley floor, and in places it forms a complex pattern with other range sites. The soils in this site are in the Acacio, Arena, Corlett, Gunbarrel, Hapney, Hooper, Laney, LaSauses, McGinty, Mosca, San Arcacio, San Luis, Villa Grove, and Zinzer series. These soils are nearly level to gently sloping, They occur in positions that are slightly higher than the Wet Meadow, Salt Meadow, and Alkali Overflow range sites and are seldom if ever flooded under natural conditions. The soils vary in depth, texture, and other features. The main factors that affect plant growth are excess salts and alkali, a fluctuating water table, and a dry climate. The water table usually is 3 to 6 feet below the soil surface but at times is lower or slightly higher in some of the soils.

In the climax (potential) plant community, alkali sacaton is the most common decreaser, making up about half of the vegetation. Other decreasers are alkali cordgrass, western wheatgrass, blue grama, and four-wing saltbush. Saltgrass and greasewood (chico) each makes up about 10 percent of the stand. Among the other plants are rubber rabbitbrush, wirerush, and perennial forbs. Saltgrass and wirerush normally are not grazed by livestock if other forage is available. Greasewood and rubber rabbitbrush generally are not used by cattle or sheep. Greasewood is eaten by sheep under certain conditions but may cause poisoning.

The vegetation is a mixture of grasses and shrubs that are tolerant of salts and alkali (pl. VI, top right). The stand generally is rather open and patchy, but there is some variation caused by differences in the effects on plant growth of salts and alkali and underground water.

On much of the site, alkali sacaton is the only important grass in the potential plant community. Alkali cordgrass is prominent, however, on some of the sandier soils, and western wheatgrass and blue grama are important on soils of the Hapney series.

Saltgrass tends to replace other grasses under continued heavy grazing or other disturbance. Greasewood, rubber rabbitbrush, and varying amounts of saltgrass make up nearly all the vegetation in many areas where the range condition is poor.

Artesian wells for livestock water can be developed on this site. Control of greasewood (chico) is a good practice on all soils where the brush has increased enough to seriously reduce grass production but where grass remains enough to use the extra moisture made available by brush removal.

The estimated annual yield of air-dry plant material is 600 to 1,200 pounds per acre. About 420 to 840 of this provides grazing for cattle.

Sand Hummocks Range Site

This site is made up of low dunes that commonly are intermingled with areas of the Salt Flats range site or with areas of Hooper clay loam. The soils in the site are in the Corlett series. They are very strongly alkaline. Nearly all the moisture that falls is stored in the soil, but alkali reduces the availability of moisture to many plants that might otherwise grow on the site. A water table in material underlying the soil benefits deep-rooted shrubs but has little effect on grasses.

In the climax (potential) plant community, fourwing saltbush is the most common decreaser, making up about 30 percent of the vegetation. Other decreasers are alkali sacaton, alkali cordgrass, thickspike wheatgrass, spike dropseed, sand dropseed, and Indian ricegrass, which together make up about 15 percent of the stand. Among the other plants are greasewood (chico), which makes up 20 percent, and rubber rabbitbrush, saltgrass, sandhill muhly, and blue grama. Saltgrass generally is not perferred by livestock if other forage is available. Greasewood (chico), rubber rabbitbrush, and sandhill muhly generally are not used by cattle or sheep. Greasewood is eaten by sheep under certain conditions but may cause poisoning.

Closely grazed remnants of four-wing saltbush indicate that this shrub was an important decreaser in the original vegetation. Indian ricegrass, blue grama, dropseeds, and sandhill muhly occur in small included areas of less alkaline sand on the crests of the dunes. The plant cover, at best, is only enough to keep the sand from drifting.

Most of the site is in poor condition. Grasses are extremely scarce. A sparse stand of greasewood and rubber rabbitbrush makes up nearly all the vegetation, and these plants are subject to damage from drifting sand.

The estimated annual yield of air-dry plant material is 300 to 600 pounds per acre. About 180 to 360 of this provides grazing for cattle.

Valley Sand Range Site

This site is on smooth to undulating terrain along the eastern edge of the valley floor and on low, broad sandbars within the valley. The soils in this site are in the Littlebear, Mosca, and Space City series. The sandy surface layer takes water readily and is not seriously affected by salts and alkali, but alkali occurs at lower depths. Consequently, grasses typical of sandy soils are mixed with salt-tolerant shrubs. The water table is 6 feet or more below the surface and has little effect on grasses but may influence the growth of shrubs. The plant cover is more uniform and more productive than that of the Sand Hummocks range site.

In the potential plant community, Indian ricegrass is the most common decreaser, making up about 15 percent of the vegetation. Other decreasers are spike dropseed, alkali cordgrass, alkali sacaton,

four-wing saltbush, thickspike wheatgrass, needle-and-thread, and low creeping wildrye, which together make up 50 percent of the stand. Among the other plants are blue grama, sand dropseed, greasewood, rubber rabbitbrush, and scurf-pea and other perennial forbs. Perennial forbs commonly are not grazed by livestock if other forage is available. Greasewood and rubber rabbitbrush generally are not used by cattle or sheep.

Although Indian ricegrass normally is the main decreaser, alkali sacaton and alkali cordgrass are prominent in some places. Plants that generally are prominent if the site is in poor condition are rabbitbrush or greasewood, pricklypear, and such low-value grasses as sandhill muhly. Weak, widely spaced plants of blue grama provide the only forage in some places.

Some areas of this site may benefit from control of greasewood (chico), which is most common on Mosca and Littlebear soils. Artesian wells for livestock water can be developed on most of the site within the survey area, except for the Littlebear soils.

The estimated annual yield of air-dry plant material is 650 to 1,200 pounds per acre. About 480 to 900 of this provides grazing for cattle.

Deep Sand Range Site

This site is in gently rolling, dunelike areas next to large, bare sand dunes in the northeastern part of the survey area. Cotopaxi sand, hilly, is the only soil in the site. This sandy soil is well drained and free of salts. It takes in all the moisture that normally falls, and a large part of this moisture is available to plants. The soil has a high potential for grass production within limits of the climate. It is readily affected by soil blowing, however, if the plant cover is damaged, and many raw blowouts have been formed.

In the potential plant community, Indian ricegrass is the most common decreaser, making up about 60 percent of the vegetation. Other decreasers are needle-and-thread and spike dropseed. Among the other plants are sand dropseed, spiny muhly, blowout grass, blue grama, and such perennial forbs as scurf-pea. Spiny muhly generally is not grazed by cattle or sheep. Blowout grass normally is not used by livestock if other forage is available.

Normally, the plants are rather widely spaced (pl. VI, bottom). There are indications outside the survey area that prairie sandreed was important in the original vegetation. Blowout grass and sandhill muhly generally become abundant if grazing is heavy. An invasion of annual weeds and a large increase in such unpalatable plants as sandhill muhly, rabbitbrush, and yucca generally occur if the condition of the site declines to poor. These changes commonly are accompanied by a serious thinning of the plant cover that leads to severe soil blowing.

The estimated annual yield of air-dry plant material is 700 to 1,200 pounds per acre. About 560 to 960 of this provides grazing for cattle.

Sandy Bench Range Site

This site consists of smooth, gently sloping soils between the valley floor and the stony mountain slopes on the eastern side of the valley. The soils are in the Costilla and Space City series. They are sandy and well drained. They take in water rapidly and are deep enough to store most of the moisture that falls. The amount of rainfall is slightly higher in these areas than in the closed basins of the valley, and the sandy soils allow plants to make good use of moisture. These soils are subject to soil blowing if the plant cover is damaged, but they are more stable than those of the Deep Sand range site. Consequently, the plant cover tends to be more dense and more uniform, and there is a higher percentage of blue grama.

In the potential plant community, Indian ricegrass is the most common decreaser, making up about 30 percent of the vegetation. Other decreasers are spike dropseed and needle-and-thread, which together make up 25 percent of the stand. Among the other plants are blue grama, which makes up 20 percent, and sand dropseed, buckwheat, low rabbitbrush, and perennial forbs. Buckwheat and low rabbitbrush generally are not grazed by cattle or sheep.

Blue grama increases under heavy grazing but is eventually thinned out if such use continues. It commonly is the main plant in areas where the site is in fair condition. Under prolonged overgrazing, the site will likely be taken over by plants of little value to livestock, such as rabbitbrush, pricklypear, and sandhill muhly.

The estimated annual yield of air-dry plant material is 700 to 1,200 pounds per acre. About 560 to 960 of this provides grazing for cattle.

Foothill Sand Range Site

This site is at the foot of the Sangre de Cristo Range. Mount Home-Sagauche cobbly sandy loams, 4 to 12 percent slopes, are the only soils in the site. These soils take in water rapidly and are deep enough to store most of the moisture that falls. The vegetation is similar to that of the Sand Bench range site, but the productive potential of the Foothill Sand range site is slightly higher and several shrub species are more common because of higher rainfall.

In the potential plant community, needle-and-thread is the most common decreaser, making up about 25 percent of the vegetation. Other decreasers are Indian ricegrass, spike dropseed, and thickspike wheatgrass, which together make up about 30 percent of the stand. Among the other plants are blue grama, four-wing saltbush, sand dropseed, winterfat, skunkbush sumac, gooseberry, Apache-plume, pinyon pine, and perennial forbs. Skunkbush sumac, gooseberry, Apache-plume, and pinyon pine generally are not grazed by cattle or sheep.

There are a few juniper trees and, in places, a few ponderosa pines. Shrubs and trees are most common along drainageways.

Under prolonged heavy grazing, blue grama generally increases until it is the main forage plant, and there is a definite increase in rabbitbrush, pricklypear, pingue, and other plants of little or no forage value. Loss of plant cover can lead to serious gullying.

The estimated annual yield of air-dry plant material is 800 to 1,400 pounds per acre. About 640 to 1,100 of this provides grazing for cattle.

Use and Management of the Soils for Wildlife 3/

Wildlife, once essential for the survival of settlers and explorers, is now important primarily for outdoor recreation and esthetic purposes. To produce wildlife, the environment must supply certain needs common to all animals. Areas must be present where wildlife can feed, rest, sleep, hide, breed, and rear their young. These are basic needs, and the degree to which they are satisfied largely determines the kind and number of wildife present in an area.

Soil is part of the environment, and from it must come food, cover, and water. Wildlife, therefore, just as livestock, grass, grains, or potatoes, is a product of the land. Soils have certain characteristics that limit their suitability as wildife habitat, and these must be considered when planning for the development of such habitat. Table 3 shows the suitability of the soils, by soil associations, as habitat for the major kinds of wildife in the Alamosa Area. The general soil map at the back of this survey shows, in color, the location of the soil associations in the Area.

Water, both its quantity and quality, is the main limitation that affects many developments of wildlife habitat in the Alamosa Area. Water is available in some areas, such as those that are irrigated, and here pheasants and other kinds of wildife can prosper. In many places, however, sufficient water is lacking and a supplemental supply must be provided. Also, saline and alkali soils affect the quality of water and greatly limit the choice of plants that can be used for food and cover. For these reasons, water and soils must be considered in planning for most wildlife developments in the survey area.

In addition to water and soil limitations, the short growing season limits use of some plants as food for wildlife. Corn, for example, is a choice food for many kinds of wildife, but it is unsuitable for planting because the short growing season keeps the corn from maturing.

In irrigated areas the amount of cover generally is limited. Plants that provide permanent cover grow along irrigation ditches, but commonly they are removed to conserve irrigation water. In places where cover is scarce, the existing plants should be preserved for wildlife.

3/ By ELDIE W. MUSTARD, State Biologist, Soil Conservation Service, Denver, Colorado.

Technical information and assistance in planning for wildlife developments can be obtained through the local office of the Soil Conservation Service. The wildlife conservation officer of the Colorado Division of Game, Fish, and Parks also can furnish information and advice on subjects related to wildlife.

Use of the Soils for Recreation 4/

Knowledge of soils is necessary in planning, developing, and maintaining areas used for recreation. In table 4, most of the soils in the Alamosa Area are rated according to limitations that affect their suitability for playgrounds, camp areas, picnic areas, and paths and trails.

In table 4, the soils are rated as having slight, moderate, or severe limitations for the specified uses. For all of these ratings, it is assumed that a good cover of vegetation can be established and maintained. A limitation of slight means that the soil properties are generally favorable and limitations are so minor that they can be easily overcome. A moderate limitation is one that can be overcome or modified by planning, by design, or by special maintenance. A limitation of severe means that costly soil reclamation, special design, intense maintenance, or a combination of these is required.

Playgrounds are areas used intensively for baseball, football, badminton, and similar organized games. Soils suitable for this use need to withstand intensive foot traffic. The best soils for this use have a nearly level surface free of coarse fragments and rock outcrops, good drainage, freedom from flooding during periods of heavy use, and a surface that is firm after rains but not dusty when dry. If grading and leveling are required, depth to rock is important.

Camp areas are used intensively for tents and small camp trailers and the accompanying activities of outdoor living. Little preparation of the site is required other than shaping and leveling for tent and parking areas. Camp areas are subject to heavy foot traffic and limited vehicular traffic. The best soils for this use have mild slopes, good drainage, a surface free of rocks and coarse fragments, freedom from flooding during periods of heavy use, and a surface that is firm after rains but not dusty when dry.

Picnic areas are attractive natural or landscaped tracts used primarily for preparing meals and eating outdoors. These areas are subject to heavy foot traffic. Most of the vehicular traffic, however, is confined to access roads. The best soils for this use are firm when wet but not dusty when dry, are free of flooding during the season of use, and do not have slopes or stoniness that greatly increase the cost of leveling sites or of building access roads.

4/ By ELDIE W. MUSTARD, State biologist, Soil Conservation Service, Denver, Colorado.

TABLE 3.--SUITABILITY OF SOIL ASSOCIATIONS FOR WILDLIFE HABITAT

[A rating of 1 denotes highly suited; 2 denotes suited; 3, poorly suited; 4, not suited; and 5, not applicable or not needed]

Soil association	Wildlife	Suitability for-- Food	Cover	Water: Natural streams, lakes, and ponds	Water: Developed lakes and ponds
1. Gunbarrel-Mosca-San Luis.	Jackrabbit	1	1	5	5
	Cottontail	1	1	5	5
	Pheasant	3	3	4	3
	Mourning dove	3	5	4	3
	Waterfowl	3	3	4	3
	Fish	5	5	4	3
2. McGinty-Gunbarrel.	Jackrabbit	1	1	5	5
	Cottontail	1	1	5	5
	Pheasant	2	2	4	4
	Mourning dove	2	5	4	4
	Waterfowl	2	2	4	4
	Fish	5	5	4	4
3. Alamosa-Vastine-Alluvial land.	Mule deer	3	2	1	2
	Jackrabbit	1	1	5	5
	Cottontail	1	1	5	5
	Pheasant	3	2	1	2
	Mourning dove	2	5	1	2
	Waterfowl	2	1	1	2
	Fish	5	5	3	2
4. San Arcacio-Acacio-Zinzer.	Mule deer	3	4	4	2
	Jackrabbit	1	1	5	5
	Cottontail	1	1	5	5
	Pheasant	1	2	4	2
	Mourning dove	1	5	4	2
	Waterfowl	1	1	4	2
	Fish	5	5	4	2
5. Hooper-Corlett.	Mule deer	4	1	4	1
	Jackrabbit	1	1	5	5
	Cottontail	1	1	5	5
	Mourning dove	4	5	4	1
	Waterfowl	4	2	4	1
	Fish	5	5	4	3
6. Costilla-Space City.	Antelope	2	5	4	4
	Mule deer	3	4	4	4
	Jackrabbit	2	1	5	5
	Cottontail	2	1	5	5
	Mourning dove	3	5	4	4
7. Uracca-Mount Home-Comodore.	Mule deer	3	1	2	3
	Elk	3	1	2	3
	Cottontail	2	1	5	5
	Mourning dove	3	5	2	3
	Fish	5	5	2	3

TABLE 3.--SUITABILITY OF SOIL ASSOCIATIONS FOR WILDLIFE HABITAT--Continued

Soil association	Wildlife	Suitability for-- Food	Cover	Water: Natural streams, lakes, and ponds	Water: Developed lakes and ponds
8. Hapney-Hooper-Corlett.	Mule deer----------------	3	2	1	2
	Jackrabbit---------------	1	1	5	5
	Cottontail---------------	1	1	5	5
	Pheasant-----------------	3	2	1	2
	Mourning dove------------	2	5	1	2
	Waterfowl----------------	2	1	1	2
	Fish---------------------	5	5	3	2
9. Cotopaxi-Dune land.	Antelope-----------------	2	5	4	4
	Mule deer----------------	3	4	4	4
	Jackrabbit---------------	2	1	5	5
	Cottontail---------------	2	1	5	5
	Mourning dove------------	3	5	4	4

TABLE 4.--SOIL INTERPRETATIONS FOR RECREATION

Soil	Degree and kind of limitations for-- Playgrounds	Camp areas	Picnic areas	Paths and trails
Acacio loam, 0 to 1 percent slopes.	None to slight--------	None to slight---------	None to slight-----	None to slight.
Acacio loam, 1 to 3 percent slopes.	Generally slight, but moderate where slopes are more than 2 percent.	None to slight---------	None to slight-----	None to slight.
Acacio loam, saline, 0 to 1 percent slopes.	Slight to moderate: water table at a depth of 2 1/2 to 5 feet.	Slight to moderate: water table at a depth of 2 1/2 to 5 feet.	None to slight-----	None to slight.
Alamosa loam-----------	Moderate: somewhat poorly drained.	Severe: flooded during season of use.	Moderate: somewhat poorly drained; may be flooded at times.	Moderate: somewhat poorly drained.
Alamosa loam, saline---	Moderate: somewhat poorly drained.	Moderate: somewhat poorly drained.	Slight to moderate: somewhat poorly drained.	Moderate: somewhat poorly drained.
Arena loam-------------	Severe: poorly drained; slow permeability.	Severe: poorly drained; water table at a depth of less than 20 inches at times.	Severe: poorly drained.	Severe: poorly drained.
Arena loam, drained----	Moderate: somewhat poorly drained.	Moderate: somewhat poorly drained.	Moderate: somewhat poorly drained.	Moderate: somewhat poorly drained.
Comodore extremely rocky loam, 40 to 150 percent slopes.	Very severe: steep slopes and stoniness.	Very severe: steep slopes and stoniness.	Very severe: steep slopes and stoniness.	Severe: steep slopes and stoniness.
Corlett sand, hilly----	Severe: sandy texture and slope.	Moderate to severe: sandy texture.	Moderate to severe: sandy texture.	Severe: sandy texture.
Corlett-Hooper complex, undulating.	Severe: sandy texture and dusty.	Severe: dusty----------	Severe: dusty------	Severe: sandy texture and dusty.

Soil	Degree and kind of limitations for--			
	Playgrounds	Camp areas	Picnic areas	Paths and trails
Costilla loamy sand, 0 to 2 percent slopes.	Moderate to severe: loamy sand texture and dust problem.	Moderate to severe: loamy sand texture and dust problem.	Moderate to severe: loamy sand texture and dust problem.	Moderate to severe: loamy sand texture.
Cotopaxi sand, hilly	Severe: sand texture	Severe: sand texture	Severe: sand texture.	Severe: sand texture.
Dune land	Very severe: loose sand.	Very severe: loose sand.	Very severe: loose sand.	Very severe: loose sand.
Graypoint-Gravelly land complex, 0 to 2 percent slopes.	Moderate to severe: more than 20 percent gravel.	Moderate: more than 20 percent gravel.	Slight to moderate: more than 20 percent gravel.	Slight to moderate: more than 20 percent gravel.
Gunbarrel loamy sand	Moderate: loamy sand; water table at a depth of 24 to 40 inches.	Moderate: loamy sand; water table at a depth of 24 to 40 inches.	Moderate: loamy sand; somewhat poorly drained.	Moderate: loamy sand; somewhat poorly drained.
Gunbarrel loamy sand, saline.	Severe: water table at a depth of 12 to 36 inches.	Severe: water table at a depth of 12 to 36 inches.	Severe: water table at a depth of 12 to 36 inches.	Moderate to severe: water table at a depth of 12 to 36 inches.
Hapney loam	Moderate: slow permeability.	Moderate: slow permeability.	Generally slight, but moderate where surface layer is clay loam.	Generally slight, but moderate where surface layer is clay loam.
Homelake loam	Slight to moderate: somewhat poorly drained.	Moderate: somewhat poorly drained; water table at a depth of 24 inches in places.	Moderate: somewhat poorly drained.	Slight to moderate: somewhat poorly drained.
Hooper loamy sand	Moderate: very slow permeability.	Moderate to severe: very slow permeability.	Moderate: loamy sand texture.	Moderate: loamy sand texture.
Hooper clay loam	Moderate to severe: clay loam; very slow permeability.	Severe: very slow permeability.	Moderate to severe: clay loam texture.	Moderate to severe: clay loam texture.
Hooper soils, occasionally flooded.	Moderate to severe: very slow permeability; flood hazard.	Severe: very slow permeability; may be flooded during season of use.	Moderate: may be flooded during season of use.	Moderate: may be flooded during season of use.
LaJara loam	Severe: poorly drained; periodic flooding.	Severe: poorly drained; periodic flooding.	Severe: poorly drained; periodic flooding.	Moderate to severe: poorly drained; periodic flooding.
Laney loam	Moderate: dust problem	Moderate: dust problem	Moderate: dust problem.	Moderate: dust problem.
LaSauses sandy clay loam.	Severe: poorly drained; water table at a depth of less than 12 inches.	Severe: poorly drained; water table at a depth of less than 12 inches.	Severe: poorly drained; water table at a depth of less than 12 inches.	Moderate to severe: water table at a depth of less than 12 inches at times.
Littlebear sandy loam, 3 to 6 percent slopes.	Moderate: slope	Slight to moderate: dust may be a problem.	Slight to moderate: dust may be a problem.	Slight.
Loamy alluvial land	Moderate: water table at a depth of 20 to 36 inches during season of use.	Moderate to severe: water table at a depth of 20 to 36 inches.	Moderate: water table at a depth of 20 to 36 inches.	Moderate: water table at a depth of 20 to 36 inches.
Marsh	Severe: water within 6 inches of surface.	Severe: water within 6 inches of surface.	Severe: water within 6 inches of surface.	Severe: water within 6 inches of surface.

TABLE 4.--SOIL INTERPRETATIONS FOR RECREATION--Continued

Soil	Degree and kind of limitations for--			
	Playgrounds	Camp areas	Picnic areas	Paths and trails
McGinty sandy loam------	None to slight--------	Slight to moderate: dust may be a problem.	Slight to moderate: dust may be a problem.	None to slight.
McGinty sandy loam, saline.	Moderate: water table at a depth of 24 inches at times.	Moderate: water table at a depth of 24 inches in season of use.	Slight to moderate: water table at a depth of 24 inches during season of use.	Slight to moderate: water table at a depth of 24 inches at times.
Medano fine sandy loam--	Moderate to severe: water table at a depth of less than 12 inches at times.	Severe: somewhat poorly drained; water table at a depth of less than 12 inches at times.	Moderate to severe: somewhat poorly drained.	Moderate: somewhat poorly drained.
Mosca loamy sand--------	Moderate to severe: loamy sand texture; dust problem.	Moderate to severe: loamy sand texture; dust problem.	Moderate to severe: loamy sand texture; dust problem.	Moderate: loamy sand texture.
Mosca loamy sand, wet---	Severe: poorly drained.	Severe: poorly drained.	Moderate to severe: water table at a depth of 24 inches.	Moderate: water table at a depth of 24 inches during season of use.
Mount Home-Saguache cobbly sandy loams, 4 to 12 percent slopes.	Severe: 65 percent of surface is covered with coarse fragments.	Severe: 65 percent of surface is covered with coarse fragments.	Severe: 65 percent of surface is covered with coarse fragments.	Severe: 65 percent of surface is covered with coarse fragments.
Nortonville loam--------	Moderate to severe: somewhat poorly drained.	Moderate to severe: somewhat poorly drained.	Moderate: somewhat poorly drained.	Moderate: somewhat poorly drained.
Peat--------------------	Very severe: organic soils; dust problem.	Very severe: organic soils; dust problem.	Very severe: organic soils; dust problem.	Very severe: organic soils; dust problem.
San Arcacio sandy loam--	Slight to moderate: moderately well drained.	Slight to moderate: water table at a depth of 36 inches.	Slight------------	Slight.
San Arcacio sandy loam, saline.	Severe: water table at a depth of 15 inches during season of use.	Severe: water table at a depth of 15 inches during season of use.	Moderate to severe: water table at a depth of 15 inches during season of use.	Moderate to severe: water table at a depth of 15 inches during season of use.
Sandy alluvial land-----	Moderate to severe: subject to flooding.	Severe: subject to flooding during season of use.	Moderate to severe: subject to flooding during season of use.	Moderate: subject to flooding.
San Luis sandy loam-----	Severe: poorly drained-	Severe: poorly drained--	Severe: poorly drained.	Severe: poorly drained.
San Luis sandy loam, drained.	Moderate: somewhat poorly drained.	Moderate to severe: somewhat poorly drained.	Moderate: somewhat poorly drained.	Moderate: somewhat poorly drained.
San Luis-Corlett complex, undulating.	Severe: sandy texture; poorly drained.	Severe: poorly drained.	Severe: poorly drained.	Severe: poorly drained.
San Luis-Gravelly land complex.	Moderate to severe: water table at a depth of 24 to 40 inches.	Severe: somewhat poorly drained.	Moderate: somewhat poorly drained.	Moderate: somewhat poorly drained.
Space City loamy fine sand, 0 to 3 percent slopes.	Slight to moderate: dust may be a problem.	Slight to moderate: dust problem.	Slight to moderate: dust problem.	None to slight.

TABLE 4.--SOIL INTERPRETATIONS FOR RECREATION--Continued

Soil	Degree and kind of limitations for--			
	Playgrounds	Camp areas	Picnic areas	Paths and trails
Space City loamy fine sand, alkali substratum, 0 to 3 percent slopes.	Slight to moderate: dust may be a problem.	Slight to moderate: dust problem.	Slight to moderate: dust problem.	None to slight.
Space City-Hooper complex, hilly.	Severe: sandy texture; dust problem.	Severe: dust problem----	Severe: dust problem.	Severe: dust problem.
Uracca very cobbly loam, 15 to 35 percent slopes.	Very severe: steep slopes; cobblestones.	Severe: steep slopes; 60 percent cobblestones.	Severe: steep slopes; 60 percent cobblestones.	Moderate to severe: steep slopes; 60 percent cobblestones.
Vastine loam------------	Severe: poorly drained; water table at a depth of 12 to 24 inches.	Severe: poorly drained; water table at a depth of 12 to 24 inches.	Severe: poorly drained; water table at a depth of 12 to 24 inches.	Moderate to severe: poorly drained; water table at a depth of 12 to 24 inches.
Villa Grove sandy clay loam, 0 to 1 percent slopes.	Slight to moderate: moderately slow permeability.	Slight to moderate: moderately slow permeability.	None to slight-----	None to slight.
Villa Grove sandy clay loam, saline, 0 to 1 percent slopes.	Moderate: water table at a depth of less than 24 inches during season of use.	Moderate: water table at a depth of less than 24 inches during season of use.	Slight to moderate: water table at a depth of less than 24 inches.	Slight to moderate: water table at a depth of less than 24 inches.
Villa Grove sandy clay loam, saline, 1 to 3 percent slopes.	Moderate: water table at a depth of less than 24 inches; slope.	Moderate: water table at a depth of less than 24 inches.	Slight to moderate: water table at a depth of less than 24 inches.	Slight to moderate: water table at a depth of less than 24 inches.
Wet alluvial land-------	Severe: poorly drained; water table at a depth of less than 12 inches.	Severe: poorly drained; water table at a depth of less than 12 inches.	Severe: poorly drained; water table at a depth of less than 12 inches.	Moderate to severe: poorly drained.
Zinzer loam, 0 to 1 percent slopes.	None to slight---------	None to slight----------	None to slight-----	None to slight.
Zinzer loam, 1 to 3 percent slopes.	Slight to moderate: slope.	None to slight----------	None to slight-----	None to slight.
Zinzer loam, saline, 0 to 1 percent slopes.	Moderate to severe: poorly drained.	Moderate to severe: poorly drained.	Moderate to severe: poorly drained.	Moderate to severe: poorly drained.

Paths and trails are used for local and cross-country travel by foot or horseback. Design and layout should require little or no cutting and filling. The best soils for this use are at least moderately well drained, are firm when wet but not dusty when dry, are flooded not more than once during the season of use, have slopes of less than 15 percent, and have few or no rocks or stones on the surface.

Engineering Uses of the Soils[5/]

This section is useful to those who need information about soils used as structural material or as foundation material upon which structures are built. Among those who can benefit from this section are planning commissions, town and city managers, land developers, engineers, contractors, and farmers.

Among the soil properties most important in engineering are permeability, shear strength, compaction characteristics, drainage condition, shrink-swell potential, grain-size distribution, plasticity, and reaction. Also important are depth to the water table, depth to bedrock, and soil slope. These properties, in various degrees and combinations, affect construction and maintenance of roads, airports, pipelines, foundations for small buildings, irrigation systems, ponds and small dams, and systems for disposal of sewage and refuse.

Information concerning these and related soil properties is furnished in tables 5, 6, and 7. The estimates and interpretations of soil properties in these tables can be used in--

1. Selecting potential residential, industrial, commercial, and recreational areas.
2. Evaluating alternate routes for roads, highways, pipelines, and underground cables.
3. Locating sources of gravel, sand, or clay.
4. Planning farm drainage systems, irrigation systems, ponds, terraces, and other structures for controlling water and conserving soil.
5. Correlating performance of structures already built with properties of the kinds of soil on which they are built, for the purpose of predicting performance of structures on the same or similar kinds of soil in other locations.
6. Predicting the trafficability of soils for cross-country movement of vehicles and construction equipment.
7. Developing preliminary estimates pertinent to construction in a particular area.

Tables 5, 6, and 7 show, respectively, several estimated soil properties significant in engineering, interpretations for various engineering uses, and results of engineering laboratory tests on soil samples. This information, along with the soil map and other parts of this survey, can be used to make interpretations in addition to those given in tables 5 and 6, and it also can be used to make other maps.

This information, however, does not eliminate the need for further investigations at sites selected for engineering works, especially works that involve heavy loads or that require excavations to depths greater than those shown in the tables, generally depths greater than 5 feet. Also, inspection of sites, especially small ones, is needed because many delineated areas of a given mapping unit may contain small areas of other soils that have strongly contrasting properties and different suitabilities or limitations for soil engineering.

Some of the terms used in this soil survey have special meaning to soil scientists that is not known to all engineers. The Glossary defines many of these terms.

Engineering Soil Classification Systems

The two systems most commonly used in classifying soils for engineering (12) are the Unified system (20) used by the SCS engineers, the Department of Defense, and others and the AASHO system adopted by the American Association of State Highway Officials (1).

In the Unified system, soils are classified according to particle-size distribution, plasticity, liquid limit, and organic-matter content. Soils are grouped in 15 classes. There are eight classes of coarse-grained soils, identified as GW, GP, GM, GC, SW, SP, SM, and SC; six classes of fine-grained soils, identified as ML, CL, OL, MH, CH, and OH; and one class of highly organic soils, identified as Pt. Soils on the borderline between two classes are designated by symbols for both classes, for example, ML-CL.

The AASHO system is used to classify soils according to those properties that affect use in highway construction and maintenance. In this system, a soil is placed in one of seven basic groups that range from A-1 through A-7 on the basis of grain-size distribution, liquid limit, and plasticity index. In group A-1 are gravelly soils of high bearing strength, or the best soils for subgrade (foundation). At the other extreme are clay soils that have low strength when wet and are the poorest soils for subgrade. Where laboratory data are available to justify a further breakdown, the A-1, A-2, and A-7 groups are subdivided as follows: A-1-a, A-1-b, A-2-4, A-2-5, A-2-6, A-2-7; and A-7-5 and A-7-6. As an additional refinement, the engineering value of a soil material can be indicated by a group index number. Group indexes range from 0 for the best material to 20 or more for the poorest. The AASHO classification for tested soils, with group index

[5/] JOSEPH F. HARVATIN, area engineer, Soil Conservation Service, Durango, Colorado, assisted in preparing this section.

numbers in parentheses, is shown in table 7; the estimated classification, without group index numbers, for all soils mapped in the survey area is given in table 5.

Soil Properties Significant in Engineering

Several estimated soil properties significant in engineering are given in table 5. These estimates are made for typical soil profiles, by layers sufficiently different to have different significance for soil engineering. The estimates are based on field observations made in the coarse of mapping, on test data for these and similar soils, and on experience with the same kinds of soil in other survey areas. Following are explanations of some of the columns in table 5.

Depth to seasonal high water table is the distance from the surface of the soil to the highest level that ground water reaches in the soil during most years.

USDA texture is determined by the relative proportions of sand, silt, and clay in soil material that is less than 2 millimeters in diameter. If the soil contains gravel or other particles coarser than sand, an appropriate modifier is added. The relative proportions of the different size particles in the soil samples are determined through mechanical analysis made by a combination of sieve and hydrometer methods.

Permeability is that quality of a soil that enables it to transmit water or air. It is estimated on the basis of soil characteristics observed in the field, particularly structure and texture. The estimates in table 5 do not take into account lateral seepage or such transient soil features as plowpans and surface crusts.

Available water capacity is the ability of soils to hold water for use by most plants. It is commonly defined as the difference between the amount of soil water at field capacity and the amount at wilting point.

Reaction is the degree of acidity or alkalinity of a soil, expressed in pH values. The pH value and terms used to describe soil reaction are explained in the Glossary.

Salinity refers to the amount of soluble salts in the soil. It is expressed as the electrical conductivity of the saturation extract, in millimhos per centimeter at 25° C. Salinity affects the suitability of a soil for crop production, its stability when used as construction material, and its corrosiveness to metals and concrete.

Shrink-swell potential is the relative change in volume to be expected of soil material with changes in moisture content; that is, the extent to which the soil shrinks as it dries out or swells when it gets wet. Extent of shrinking and swelling is influenced by the amount and kind of clay in the soil. Shrinking and swelling of soils cause much damage to building foundations, roads, and other structures. A high shrink-swell potential indicates a hazard to the maintenance of structures built in, on, or with material having this rating.

Hydrologic grouping.--Hydrologic soil groups are used in watershed planning to estimate runoff from rainfall. Soil properties are considered that influence the minimum rate of infiltration obtained for a bare soil after prolonged wetting. These properties are depth of seasonally high water table, intake rate and permeability after prolonged wetting, and depth to very slowly permeable layer. The influence of ground cover is treated independently, not in hydrologic soil groupings.

The soils have been classified into four groups, A through D.

Group A soils are those having a low runoff potential. These soils have a high (rapid) infiltration rate, even when thoroughly wetted, and consist chiefly of deep, well-drained to excessively drained sands or gravels. They have a high rate of water transmission.

Group B soils are those having a moderately low runoff potential. These soils have a moderate infiltration rate when thoroughly wetted and consist chiefly of moderately deep to deep, moderately well drained to well drained soils with a moderately fine to a moderately coarse texture and moderately slow to moderately rapid permeability. They have a moderate rate of water transmission.

Group C soils are those having a moderately high runoff potential. These soils have a slow infiltration rate when thoroughly wetted and consist chiefly of soils with a layer that impedes downward movement of water, soils with a moderately fine to fine texture, soils with slow infiltration because of salts or alkali, or soils with a moderate water table. They have a slow rate of water transmission.

Group D soils are those having a high runoff potential. These soils have a very slow infiltration rate when thoroughly wetted and consist chiefly of clay soils with a high swelling potential, soils with a permanent high water table, soils with a claypan or clay layer at or near the surface, soils with very slow infiltration because of salts or alkali, and shallow soils over nearly impervious material. These soils have a very slow rate of water transmission.

Engineering Interpretations

The estimated interpretations in table 6 are based on the engineering properties of soils shown in table 5, on test data for soils in this survey area and others nearby or adjoining, and on the experience of engineers and soil scientists with the soils of the Alamosa Area. In table 6, ratings are used to summarize limitation or suitability of the soils for all listed purposes other than for highway location, dikes and diversions, farm ponds, agricultural drainage, and irrigation. For these particular uses, table 6 lists those soil features not to be overlooked in planning, installation, and maintenance.

Soil limitations are indicated by the ratings slight, moderate, severe, and unsuitable. Slight

means soil properties generally favorable for the rates used, or in other words, limitations that are minor and easily overcome. Moderate means soil properties are unfavorable but can be overcome or modified by special planning and design. Severe means soil properties so unfavorable and so difficult to correct or overcome as to require major soil reclamation and special designs.

Soil suitability is rated by the terms good, fair, poor, and unsuitable, which have, respectively, meanings approximately parallel to the terms slight, moderate, severe, and unsuitable.

Topsoil is used for topdressing an area where vegetation is to be established and maintained. Suitability is affected mainly by ease of working and spreading the soil material, as for preparing a seedbed; by the natural fertility of the material, of the response of plants when fertilizer is applied, and by the absence of substances toxic to plants. Texture of the soil material and its content of stone fragments are characteristics that affect suitability, but also considered in the ratings is damage that results at the area from which topsoil is taken.

Sand and gravel are used in great quantities in many kinds of construction. The ratings in table 6 provide guidance about where to look for probable sources. A soil rated as a good or fair source of sand or gravel generally has a layer at least 3 feet thick, the top of which is within a depth of 6 feet. The ratings do not take into account thickness of overburden, location of the water table, or other factors that affect mining of the materials, and neither do they indicate quality of the deposit.

Road fill is soil material used in embankments for roads. The suitability ratings reflect (1) the predicted performance of soil after it has been placed in an embankment that has been properly compacted and provided with adequate drainage and (2) the relative ease of excavating the material at borrow areas.

Septic tank filter fields are subsurface systems of tile or perforated pipe that distribute effluent from a septic tank into natural soil. The soil material from a depth of 18 inches to 6 feet is evaluated. The soil properties considered are those that affect both absorption of effluent and construction and operation of the system. Properties that affect absorption are permeability, depth to water table or rock, and susceptibility to flooding. Slope is a soil property that affects difficulty of layout and construction and also the risk of soil erosion, lateral seepage, and downslope flow of effluent. Large rocks or boulders increase construction costs.

Homesites, as rated in table 6, are sites for dwellings that are not more than three stories high and are supported by foundation footings placed in undisturbed soil. The features that affect the rating of a soil for homesites are those that relate to capacity to support load and resist settlement under load and those that relate to ease of excavation. Soil properties that affect capacity to support load are wetness, susceptibility to flooding, density, plasticity, texture, and shrink-swell potential. Those that affect excavation are wetness, slope, depth to bedrock, and content of stones and rocks.

In estimating the soil features that affect selection of highway location, evaluation is for the profile of an undisturbed soil that has not been drained but has had its organic surface layer removed, if one occurs. Some of the features considered are the height of the water table, the hazard of flooding, the stability of the soil material, particularly under heavy loads of pressure, depth to and kind of bedrock, degree of frost hazard, and slope.

Stability, slope, piping hazard, permeability, height of the water table, erodibility of the soil material, and content of salts and alkali are some of the soil features affecting dikes and diversions.

Reservoir areas hold water behind a dam or embankment. Soils suitable for pond reservoir areas have low seepage, which is related to their permeability and depth to fractured or permeable bedrock or other permeable material.

Embankments require soil material resistant to seepage and piping and of favorable stability, shrink-swell potential, shear strength, and compactability. Stones or organic material in a soil are among the factors that are unfavorable.

Agricultural drainage is affected by such soil properties as permeability, texture, and structure; depth to claypan, rock, or other layers that influence rate of water movement; depth to the water table; slope; stability in ditchbanks; susceptibility to stream overflow; salinity or alkalinity; and availability of outlets for drainage.

Irrigation of a soil is affected by such features as slope; susceptibility to stream overflow, water erosion, or soil blowing; soil texture; content of stones; accumulations of salts and alkali; depth of rooting zone; rate of water intake at the surface; permeability of soil layers below the surface layer and in layers that restrict movement of water; amount of water held available to plants; and need for drainage, or depth to water table or bedrock.

Corrosivity, as used in table 6, pertains to potential soil-induced chemical action that dissolves or weakens untreated steel or concrete. Rate of corrosion of untreated steel pipe is related to such soil properties as drainage, texture, total acidity, and electrical conductivity of the soil material. Corrosivity for concrete is influenced mainly by the content of sodium or magnesium sulfate, but also by soil texture and acidity. Installations of untreated steel that intersect soil boundaries or soil horizons are more susceptible to corrosion than installations entirely in one kind of soil or in one soil horizon. A corrosivity rating of low means that there is a low probability of soil-induced corrosion damage. A rating of high means that there is a high probability of damage, so that protective measures for steel and more resistant concrete should be used to avoid or minimize damage.

[An asterisk in the first column indicates that at least one mapping unit in this series is made up of two or
reason it is necessary to follow carefully the instructions for referring to other series that appear in

Soil series and map symbols	Depth to seasonal high water table 1/	Depth from surface	Classification: Dominant USDA texture	Classification: Unified	Classification: AASHO
	Feet	Inches			
Acacio:					
AaA, AaB	(3/)	0-4	Sandy loam	SM	A-4
		4-16	Clay loam to loam	CL or SC	A-6
		16-44	Gypsiferous loam	ML	A-4
		44-60	Clay loam	CL	A-6
AcA	2½-3½	0-4	Sandy loam	SM	A-4
		4-16	Clay loam to loam	CL or SC	A-6
		16-44	Gypsiferous loam	ML	A-4
		44-60	Clay loam	CL	A-6
Alamosa:					
Am	1-2½	0-8	Loam	ML	A-4
		8-55	Clay loam to loam	CL	A-6
		55-65	Sand	SM-SP	A-3
An	1-2½	0-8	Loam	ML	A-4
		8-55	Clay loam to loam	CL	A-6
		55-65	Sand	SM-SP	A-3
Arena:					
Ar	1½-3	0-33	Clay loam	CL	A-6
		33-48	Indurated hardpan	-----	--------
		48-60	Sand	SM	A-2
As	2½-5	0-33	Clay loam	CL	A-6
		33-48	Indurated hardpan	-----	--------
		48-60	Sand	SM	A-2
Comodore: CmF	(3/)	0-15	Very stony loam	ML	A-4
		>15	Granitic bedrock.		
*Corlett: CoE, CpB. For properties of the Hooper soil in mapping unit CpB, refer to mapping unit Hp under the Hooper series.	3½-5+	0-60	Sand	SM	A-2
Costilla: CsA	(3/)	0-41	Loamy sand and gravelly loamy sand.	SM	A-2
		41-60	Gravelly sand	SM	A-2
Cotopaxi: CtE	(3/)	0-60	Sand	SP-SM or SP	A-3
Dune land: Du	(3/)	0-60	Sand	SP-SM or SP	A-3

See footnotes at end of table.

more kinds of soil. The soils in such mapping units may have different properties and limitations, and for this the first column in this table. > means more than; < means less than]

Percentage passing sieve 2/-- No. 4 (4.7 mm.)	No. 10 (2.0 mm.)	No. 200 (0.074 mm.)	Permeability	Available water-holding capacity	Reaction 1:5 dilution	Salinity	Shrink-swell potential	Hydrologic group
			Inches per hour	Inches per in. of soil	pH	Millimhos per cm. at 25°C.		
95-100	85-100	35-45	2.0-6.0	0.11-0.13	8.5-9.0	0-4	Low.	B
95-100	95-100	45-65	0.6-2.0	0.12-0.21	7.9-9.0	0-15	Moderate.	
100	100	55-65	0.6-2.0	0.08-0.16	7.4-8.4	4-15	Low.	
100	100	80-90	0.20-0.6	0.19-0.21	7.9-8.4	2-8	Moderate.	
95-100	85-100	35-45	2.0-6.0	0.08-0.11	8.5-9.0	8-30	Low.	C
95-100	95-100	45-65	0.6-2.0	0.12-0.21	7.9-9.0	8-15	Moderate.	
100	100	55-65	0.6-2.0	0.08-0.16	7.4-8.4	8-15	Low.	
100	100	80-90	0.20-0.6	0.19-0.21	7.9-8.4	4-8	Moderate.	
100	100	60-75	0.6-2.0	0.16-0.18	7.9-9.0	0-4	Moderate.	C
100	100	70-85	0.20-0.6	0.19-0.21	7.9-9.0	0-4	Moderate.	
100	100	5-10	> 10.0	0.04-0.06	7.4-8.4	0-4	Low.	
100	100	60-75	0.6-2.0	0.12-0.14	7.9-9.0	8-15	Moderate.	C
100	100	70-85	0.20-0.6	0.14-0.18	7.9-9.0	4-15	Moderate.	
100	100	5-10	> 10.0	0.04-0.06	7.4-8.5	4-15	Low.	
100	100	60-70	0.06-0.20	0.08-0.10	8.5-10.5	8-30	Moderate.	C
------	------	-----	< 0.06	---------	8.5-10.0	----	---------	
100	100	10-20	> 10.0	0.04-0.06	8.5-10.0	2-4	Low.	
100	100	60-70	0.06-0.20	0.12-0.14	8.5-10.5	2-4	Moderate.	C
------	------	-----	< 0.06	---------	8.5-10.0	----	---------	
100	100	10-20	> 10.0	0.04-0.06	8.5-10.0	2-4	Low.	
85-95	80-90	50-65	0.6-2.0	0.08-0.10	6.1-6.5	0-1	Low.	D
100	100	10-20	> 5.0	0.04-0.06	9.1-10.5	0-4	Low.	A
80-95	75-85	15-30	6.0-20.0	0.05-0.08	7.9-9.0	0-2	Low.	A
70-90	65-85	15-25	6.0-20.0	0.04-0.07	7.9-9.5	0-2	Low.	
100	100	0-10	> 5.0	0.04-0.06	7.4-7.8	0-2	Low.	A
100	100	0-10	> 10.0	0.04-0.06	7.4-7.8	0-2	Low.	A

Soil series and map symbols	Depth to seasonal high water table 1/	Depth from surface	Classification: Dominant USDA texture	Classification: Unified	Classification: AASHO
	Feet	Inches			
Graypoint: GgA---------- Properties are for the Graypoint soils; properties for Gravelly land in this mapping unit are too variable to estimate.	(3/)	0-4	Gravelly sandy loam--------	SM	A-2
		4-12	Sandy clay loam------------	SC	A-4 or A-2
		12-60	Sand and gravel------------	GP or GM-GP	A-1
Gunbarrel:					
Gn--------------------	2-4	0-48	Loamy coarse sand----------	SM	A-2
		48-60	Sand and gravel------------	SM or SP-SM	A-1
Gs--------------------	1-3	0-48	Loamy coarse sand----------	SM	A-2
		48-60	Sand and gravel------------	SM or SP-SM	A-1
Hapney: Ha--------------	(3/)	0-40	Clay loam to loam----------	CL	A-6
		40-60	Sand-----------------------	SM or SM-SP	A-1 or A-3
Homelake: Hm------------	2-3½	0-30	Loam-----------------------	ML	A-4
		30-40	Fine sandy loam------------	SM	A-4
		40-60	Sand and gravel------------	SM or SP-SM	A-1 or A-3
Hooper:					
Ho---------------------	4-5+	0-7	Loamy sand-----------------	SM	A-2
		7-16	Clay loam------------------	CL	A-6 or A-7
		16-32	Sandy loam-----------------	SM	A-2 or A-4
		32-60	Sand-----------------------	SM	A-2
Hp--------------------	4-5+	0-16	Clay loam or clay----------	CL	A-6 or A-7
		16-32	Sandy loam-----------------	SM	A-2 or A-4
		32-60	Sand-----------------------	SM	A-2
Hs--------------------	2-3	0-7	Loamy sand-----------------	SM	A-2
		7-16	Clay loam------------------	CL	A-6 or A-7
		16-32	Sandy loam-----------------	SM	A-2 or A-4
		32-60	Sand-----------------------	SM	A-2
LaJara: La--------------	1½-2½	0-50	Stratified very fine sandy loam and loam.	ML	A-4
		50-60	Sand-----------------------	SM or SP-SM	A-3 or A-2
Laney: Le---------------	(3/)	0-28	Loam-----------------------	CL	A-4
		28-60	Stratified sand, sandy loam, and clay loam.	SM	A-2 or A-4
LaSauses: Ls------------	1-2½	0-17	Clay loam to loam----------	CL	A-6
		17-60	Clay-----------------------	MH	A-7

See footnotes at end of table.

Percentage passing sieve 2/-- No. 4 (4.7 mm.)	No. 10 (2.0 mm.)	No. 200 (0.074 mm.)	Permeability	Available water-holding capacity	Reaction 1:5 dilution	Salinity	Shrink-swell potential	Hydrologic group
			Inches per hour	Inches per in. of soil	pH	Millimhos per cm. at 25° C.		
90-95	80-90	20-35	2.0-6.0	0.10-0.12	7.4-7.8	0-2	Low.	B
90-95	85-95	30-50	0.6-2.0	0.14-0.16	7.9-9.0	0-2	Moderate.	
25-45	20-40	0-10	>10.0	0.03-0.05	7.4-8.4	0-2	Low.	
90-100	90-100	15-30	6.0-20.0	0.07-0.09	7.9-10.0	0-2	Low.	A
75-90	65-80	5-15	>10.0	0.03-0.05	7.9-10.0	0-2	Low.	
90-100	90-100	15-30	6.0-20.0	0.07-0.09	7.9-10.0	8-30	Low.	C
75-90	65-80	5-15	>10.0	0.03-0.05	7.9-10.0	0-2	Low.	
100	100	60-70	0.06-0.20	0.14-0.16	7.9-9.6	0-4	Moderate.	C
100	100	5-15	>10.0	0.05-0.07	8.5-9.0	0-2	Low.	
95-100	95-100	50-70	0.6-2.0	0.16-0.18	7.4-7.8	0-2	Moderate.	B (drained)
90-100	85-95	35-45	2.0-6.0	0.13-0.15	7.4-7.8	0-2	Low.	C (undrained)
75-95	65-85	5-15	>10.0	0.03-0.05	7.4-7.8	0-2	Low.	
100	95-100	15-30	2.0-6.0	0.06-0.08	9.0-10.0	0-4	Low.	D
100	100	60-75	<0.06	0.04-0.06	9.0-10.5	4-8	Moderate to high.	
100	100	30-40	2.0-6.0	0.04-0.06	9.0-10.5	2-4	Low.	
95-100	90-100	10-20	>10.0	0.03-0.05	9.0-10.0	0-4	Low.	
100	100	60-75	<0.06	0.04-0.06	9.0-10.0	4-8	Moderate to high.	D
100	100	30-40	2.0-6.0	0.04-0.06	9.0-10.5	2-4	Low.	
95-100	90-100	10-20	>5.0	0.03-0.05	9.0-10.5	0-4	Low.	
100	95-100	15-30	2.0-6.0	0.06-0.08	9.0-10.0	15-30	Low.	D
100	100	60-75	<0.06	0.04-0.06	9.0-10.5	15-30	Moderate to high.	
100	100	30-40	2.0-6.0	0.04-0.06	9.0-10.5	15-30	Low.	
95-100	90-100	10-20	>10.0	0.03-0.05	9.0-10.0	8-15	Low.	
100	100	55-80	0.6-2.0	0.15-0.17	6.6-8.4	0-4	Low.	C
100	100	5-15	>5.0	0.04-0.06	7.4-7.8	0-2	Low.	
100	100	50-65	0.6-2.0	0.16-0.18	9.0-10.5	4-15	Moderate.	B
100	95-100	20-50	0.6-6.0	0.10-0.12	7.4-8.4	4-8	Low to moderate.	
100	100	70-80	0.06-0.20	0.10-0.12	7.0-9.0	8-30	Moderate.	D
100	100	85-95	<0.06	0.07-0.09	5.0-6.5	8-30	High.	

Soil series and map symbols	Depth to seasonal high water table 1/	Depth from surface	Classification: Dominant USDA texture	Classification: Unified	Classification: AASHO
	Feet	Inches			
Littlebear: LtC---------	(3/)	0-23	Sandy loam-----------------	SM	A-2 or A-4
		23-60	Loamy sand-----------------	SM	A-2
Loamy alluvial land: Lu--	1½-3	0-36	Loam and clay loam---------	CL	A-6
		36-60	Sand-----------------------	SM or SP-SM	A-2
Marsh: Ma. Properties too variable to be estimated.					
McGinty:					
Mc---------------------	(3/)	0-60	Sandy loam-----------------	SM	A-2 or A-4
Mg---------------------	2-3	0-60	Sandy loam-----------------	SM	A-2 or A-4
Medano: Mn-------------	1-2	0-12	Fine sandy loam and sandy loam.	SM	A-4
		12-45	Loamy sand-----------------	SM	A-2
		45-60	Sand-----------------------	SM or SP-SM	A-1 or A-3
Mosca:					
Mo---------------------	(3/)	0-5	Loamy sand-----------------	SM	A-2
		5-36	Sandy loam-----------------	SM	A-2 or A-4
		36-60	Sand and gravel------------	SM or SP-SM	A-3 or A-2
Ms---------------------	2-3	0-5	Loamy sand-----------------	SM	A-2
		5-36	Sandy loam-----------------	SM	A-2 or A-4
		36-60	Sand and gravel------------	SM or SP-SM	A-3 or A-2
*Mount Home: MtD--------- For properties of the Saguache soil in this mapping unit, refer to the Saguache series.	(3/)	0-60	Very cobbly sandy loam-----	GP-GM or GM	A-1
Nortonville: No---------	2-3	0-14	Loam and clay loam---------	ML or CL	A-4 or A-6
		14-60	Fine sandy loam, loam, or clay loam.	ML or CL	A-4 or A-6
Peat: Pe. Properties too variable to be estimated.					
Saguache----------------- Mapped only in a complex with the Mount Home soils.	(3/)	0-10	Loam to sandy loam---------	SC or ML	A-4 or A-2
		10-60	Cobblestones, gravel, and sand.	GP	A-1

See footnotes at end of table.

Percentage passing sieve 2/-- No. 4 (4.7 mm.)	No. 10 (2.0 mm.)	No. 200 (0.074 mm.)	Permeability	Available water-holding capacity	Reaction 1:5 dilution	Salinity	Shrink-swell potential	Hydrologic group
			Inches per hour	Inches per in. of soil	pH	Millimhos per cm. at 25° C.		
90-100 85-95	85-95 80-90	20-40 10-25	2.0-6.0 6.0-20.0	0.11-0.13 0.06-0.08	7.9-10.0 7.9-10.0	0-8 0-8	Low. Low.	B
100 95-100	100 90-95	55-80 5-15	0.20-2.0 >10.0	0.16-0.21 0.04-0.06	7.9-8.4 7.9-8.4	0-8 0-2	Moderate. Low.	C
95-100	95-100	30-45	2.0-6.0	0.11-0.13	7.4-8.4	0-4	Low.	B
95-100	95-100	30-45	2.0-6.0	0.09-0.11	7.4-8.4	4-15	Low.	C
100	100	40-50	2.0-6.0	0.13-0.15	7.4-8.4	0-2	Low.	C
100 100	100 100	10-25 5-15	6.0-20.0 >10.0	0.06-0.08 0.04-0.06	7.4-7.8 7.4-7.8	0-2 0-2	Low. Low.	
95-100 100 100	90-100 95-100 90-100	10-30 25-40 5-15	6.0-20.0 2.0-6.0 >10.0	0.06-0.08 0.11-0.13 0.05-0.07	8.5-10.0 8.5-10.0 7.9-9.0	0-4 0-8 0-4	Low. Low. Low.	B
95-100 100 100	90-100 95-100 90-100	10-30 25-40 5-15	6.0-20.0 2.0-6.0 >10.0	0.06-0.08 0.11-0.13 0.05-0.07	8.5-10.0 8.5-10.0 7.9-9.0	4-15 8-15 0-4	Low. Low. Low.	C
35-45	30-40	5-15	2.0-6.0	0.05-0.07	7.4-8.4	0-2	Low.	A
100 100	100 100	65-80 60-75	0.2-0.06 0.20-2.0	0.11-0.15 0.16-0.18	7.9-9.0 7.9-8.4	8-30 2-8	Moderate. Moderate.	C
85-95 25-50	85-95 20-40	25-60 0-5	0.6-6.0 >10.0	0.11-0.18 0.03-0.05	8.5-9.0 8.0-9.0	0-2 0-2	Low. Low.	A

Soil series and map symbols	Depth to seasonal high water table 1/	Depth from surface	Classification		
			Dominant USDA texture	Unified	AASHO
	Feet	Inches			
San Arcacio:					
Sa----------------------	3-4	0-9	Sandy loam----------------	SC or SM	A-2 or A-4
		9-17	Sandy clay loam-----------	SC	A-6
		17-60	Sand and gravel-----------	GP or GM-GP	A-1
Sc----------------------	1-3	0-9	Sandy loam----------------	SC or SM	A-2 or A-4
		9-17	Sandy clay loam-----------	SC	A-6
		17-60	Sand and gravel-----------	GP or GM-GP	A-1
Sandy alluvial land: Sd--	2-3	0-15	Gravelly sandy loam-------	SM	A-2
		15-60	Gravel and sand-----------	GP or SP or GP-GM or SP-SM	A-1
*San Luis:					
Se----------------------	1-3	0-7	Sandy loam-----------------	SM	A-2 or A-4
		7-34	Clay loam, loam, or sandy clay loam.	SC or CL	A-6
		34-60	Sand----------------------	SM or SP-SM	A-3 or A-2
Sf, Sm------------------ Properties of Gravelly land in unit Sm are too variable to be estimated.	3-4	0-7	Sandy loam-----------------	SM	A-2 or A-4
		7-34	Clay loam, loam, or sandy clay loam.	SC or CL	A-6
		34-60	Sand----------------------	SM or SP-SM	A-3 or A-2
SlB--------------------- For properties of the Corlett soils in this mapping unit, refer to the Corlett series.	1-3	0-7	Sandy loam-----------------	SM	A-2 or A-4
		7-34	Clay loam, loam, or sandy clay loam.	SC or CL	A-6
		34-60	Sand----------------------	SM or SP-SM	A-3 or A-2
*Space City:					
SpB, StE---------------- For properties of the Hooper soil in mapping unit StE, refer to mapping unit Ho under the Hooper series.	(3/)	0-60	Loamy fine sand------------	SM	A-2
SrB---------------------	(3/)	0-20	Loamy fine sand------------	SM	A-2
		20-60	Loamy fine sand------------	SM	A-2
Uracca: UrF-------------	(3/)	0-9	Very cobbly loam and very cobbly clay loam.	ML or CL	A-4 or A-6
		9-23	Very cobbly coarse sandy loam.	GM	A-1
		23-60	Cobblestones, gravel, and boulders.	GP or GW	A-1

See footnotes at end of table.

Percentage passing sieve 2/--			Permeability	Available water-holding capacity	Reaction 1:5 dilution	Salinity	Shrink-swell potential	Hydrologic group
No. 4 (4.7 mm.)	No. 10 (2.0 mm.)	No. 200 (0.074 mm.)						
			Inches per hour	Inches per in. of soil	pH	Millimhos per cm. at 25° C.		
85-95	85-95	25-45	2.0-6.0	0.11-0.13	7.9-8.4	0-4	Low.	B
90-95	85-95	35-50	0.6-2.0	0.14-0.16	7.4-8.4	0-2	Moderate.	
25-50	20-40	0-10	>10.0	0.04-0.06	7.4-9.0	0-4	Low.	
85-95	85-95	25-45	2.0-6.0	0.08-0.11	7.9-8.4	8-30	Low.	B
90-95	85-95	35-50	0.6-2.0	0.11-0.14	7.4-8.4	8-30	Moderate.	
25-50	20-40	0-10	>10.0	0.04-0.06	7.4-9.0	0-4	Low.	
75-90	65-75	20-35	2.0-6.0	0.07-0.09	7.4-8.4	0-2	Low.	A
25-75	25-75	0-10	>10.0	0.03-0.05	7.4-8.4	0-2	Low.	
100	100	30-45	2.0-6.0	0.08-0.10	8.5-10.0	8-30	Low.	C
100	100	35-80	0.20-0.6	0.13-0.16	8.5-10.0	8-30	Moderate.	
100	90-100	5-20	>5.0	0.04-0.06	8.5-10.0	0-4	Low.	
100	100	30-45	2.0-6.0	0.11-0.13	7.9-8.4	0-4	Low.	B
100	100	35-80	0.20-0.6	0.16-0.18	8.5-10.0	0-8	Moderate.	
100	90-100	5-20	>5.0	0.04-0.06	8.5-10.0	0-4	Low.	
100	100	30-45	2.0-6.0	0.11-0.13	7.9-8.4	0-4	Low.	C
100	100	35-80	0.20-0.6	0.16-0.18	8.5-10.0	0-8	Moderate.	
100	90-100	5-20	>5.0	0.04-0.06	8.5-10.0	0-4	Low.	
100	95-100	15-25	6.0-20.0	0.09-0.11	7.9-8.4	0-2	Low.	A
100	95-100	15-25	6.0-20.0	0.09-0.11	7.9-8.4	0-2	Low.	A
100	95-100	15-25	6.0-20.0	0.07-0.10	8.5-10.0	4-8	Low.	
75-90	70-80	50-60	0.6-2.0	0.06-0.08	7.9-8.4	0-2	Low.	B
40-50	35-45	10-20	6.0-20.0	0.03-0.05	7.9-8.4	0-2	Low.	
5-15	5-10	0-5	> 20.0	0.03-0.05	7.9-8.4	0-2	Low.	

Soil series and map symbols	Depth to seasonal high water table 1/	Depth from surface	Classification: Dominant USDA texture	Classification: Unified	Classification: AASHO
	Feet	Inches			
Vastine: Va------------	1-2½	0-30	Clay loam, loam, or sandy clay loam.	CL or ML	A-4 or A-6
		30-60	Stratified sand and loamy sand.	SM	A-1 or A-2
Villa Grove:					
VgA-------------------	(3/)	0-34	Clay loam and sandy clay loam.	CL	A-6
		34-44	Sandy loam-----------------	SM	A-2 or A-4
		44-60	Silty clay loam------------	CL	A-6
VlA, VlB--------------	2-4	0-34	Clay loam and sandy clay loam.	CL	A-6
		34-44	Sandy loam-----------------	SM	A-2 or A-4
		44-60	Silty clay loam------------	CL	A-6
Wet alluvial land: Wa--	1-2	0-36	Loam and clay loam---------	CL	A-6
		36-60	Sand-----------------------	SM or SP-SM	A-2
Zinzer:					
ZnA, ZnB--------------	(3/)	0-60	Loam, sandy loam, and sandy clay loam.	SC or CL	A-6
ZoA-------------------	2-3	0-60	Loam, sandy loam, and sandy clay loam.	SC or CL	A-6

1/ Seasons and duration of highest water table are late in spring and in summer for a total of about 90 days

2/ Based on material smaller than 3 inches. See description of series in the section "Descriptions of the Soils" for amount of material larger than 3 inches.

Percentage passing sieve 2/--			Permeability	Available water-holding capacity	Reaction 1:5 dilution	Salinity	Shrink-swell potential	Hydrologic group
No. 4 (4.7 mm.)	No. 10 (2.0 mm.)	No. 200 (0.074 mm.)						
			Inches per hour	Inches per in. of soil	pH	Millimhos per cm. at 25° C.		
100	95-100	55-70	0.20-2.0	0.16-0.21	7.4-8.4	0-4	Moderate to low.	C
95-100	85-95	10-25	6.0-20.0	0.04-0.08	7.4-8.4	0-4	Low.	
100	100	50-75	0.20-0.6	0.19-0.21	7.9-8.4	0-8	Moderate.	B
100	100	30-40	2.0-6.0	0.11-0.13	7.9-8.4	0-8	Low.	
100	100	80-90	0.20-0.6	0.19-0.21	7.9-8.4	0-4	Moderate.	
100	100	50-75	0.20-0.6	0.11-0.15	7.9-9.0	8-30	Moderate.	C
100	100	30-40	2.0-6.0	0.11-0.13	7.9-8.4	2-8	Low.	
100	100	80-90	0.20-0.6	0.19-0.21	7.9-8.4	2-8	Moderate.	
100	100	55-80	0.20-2.0	0.12-0.16	8.5-9.6	8-30	Moderate.	C
95-100	90-95	5-15	>10.0	0.04-0.06	7.4-9.0	2-8	Low.	
95-100	85-100	45-65	0.6-2.0	0.14-0.18	7.9-8.4	0-8	Low.	B
95-100	85-100	45-65	0.6-2.0	0.12-0.14	7.9-8.4	8-30	Low.	C

3/ No water table within the depth of normal observation. This is at least 5 feet.

[An asterisk in the first column indicates that at least one mapping unit in this series is made up of two or reason it is necessary to follow carefully the instructions for referring

Series and map symbols	Suitability as a source of--				Limitation for--	
	Topsoil	Sand	Gravel	Road fill	Septic tank filter fields	Homesites
Acacio: AaA, AaB	Good	Unsuitable: mostly over 50 percent fines.	Unsuitable: no gravel.	Fair: A-4 or A-6.	Severe: moderately slow permeability in substratum.	Moderate: moderate shrink-swell potential; high content of gypsum.
AcA	Fair to poor: salts.	Unsuitable: mostly over 50 percent fines.	Unsuitable: no gravel.	Fair: A-4 and A-6.	Severe: moderately slow permeability in substratum; water table at a depth of $2\frac{1}{2}$ to $3\frac{1}{2}$ feet.	Moderate to severe: water table at a depth of $2\frac{1}{2}$ to $3\frac{1}{2}$ feet; saline.
Alamosa: Am	Good	Good below a depth of 55 inches: 5 to 10 percent fines.	Unsuitable: no gravel.	Fair to a depth of 55 inches inches: A-4 and A-6. Good below a depth of 55 inches: A-3.	Severe: moderately slow permeability; water table at a depth of 1 to $2\frac{1}{2}$ feet.	Severe: water table at a depth of 1 to $2\frac{1}{2}$ feet.
An	Fair to poor; salts.	Good below a depth of 55 inches: 5 to 10 percent fines.	Unsuitable: no gravel.	Fair to a depth of 55 inches: A-4 and A-6. Good below a depth of 55 inches: A-3.	Severe: water table at a depth of 1 to $2\frac{1}{2}$ feet.	Severe: saline; water table at a depth of 1 to $2\frac{1}{2}$ feet.
Arena: Ar, As	Fair: As. Poor: Ar, salts.	Unsuitable: over 50 percent fines.	Unsuitable: no gravel.	Fair: A-6.	Severe: very slow permeability; high water table.	Moderate: As. Severe: Ar; high water table.

more kinds of soil. The soils in such mapping units may have different properties and limitations, and for this to other series that appear in the first column in this table]

Soil features affecting--						Soil corrosivity	
Highway location	Dikes and diversions	Farm ponds: Reservoir area	Farm ponds: Embankment	Agricultural drainage	Irrigation	Untreated steel pipe	Concrete conduits
High frost hazard; high content of gypsum.	Moderately slow permeability in substratum; high content of gypsum; subject to piping.	High content of gypsum; moderately slow permeability in substratum; subject to piping.	Moderately slow permeability in substratum; high content of gypsum; subject to piping.	Not needed----	Moderately slow permeability in substratum; high available water holding capacity; nearly level to very gently sloping.	Moderate to high.	High.
2½ to 3½ feet to water table; saline; high content of gypsum; high frost hazard.	Moderately slow permeability in substratum; high content of gypsum; subject to piping.	High content of gypsum; moderately slow permeability in substratum; subject to piping.	Moderately slow permeability in substratum; high content of gypsum; subject to piping.	Moderately slow permeability in substratum; leaching necessary.	Drainage necessary; high content of salt; nearly level.	High------	High.
Low bottom land; high frost hazard; water table at a depth of 1 to 2½ feet.	Moderately slow permeability; good stability.	Moderately slow permeability; slow seepage.	Moderately slow permeability; good stability; moderate shrink-swell potential.	Outlets difficult to obtain; water table at a depth of 1 to 2½ feet.	High available water holding capacity; care is needed to prevent water logging.	Moderate--	Moderate.
High frost hazard; subject to overflow; water table at a depth of 1 to 2½ feet.	Moderately slow permeability; good stability.	Moderately slow permeability; slow seepage.	Moderately slow permeability; good stability; moderate shrink-swell potential.	Outlets difficult to find; leaching necessary; water table at a depth of 1 to 2½ feet.	Drainage needed; care is needed to prevent water-logging; moderately slow permeability; slightly to moderately saline	High------	Moderate.
High water table; high frost hazard; moderate shrink-swell potential.	Water table; hardpan in substratum.	Very slow permeability; good stability.	Slow permeability; good stability.	Very slow permeability; water table; saline and alkali; nearly level.	Very slow permeability; saline and alkali; water table; nearly level	High: Ar. Moderate: As.	High: Ar. Moderate: As.

Series and map symbols	Suitability as a source of-- Topsoil	Sand	Gravel	Road fill	Limitation for-- Septic tank filter field	Homesites
Comodore: CmF-----------	Poor: very stony.	Unsuitable: 20 to 80 percent cobblestones and stones.	Unsuitable: 20 to 80 percent cobblestones and stones.	Poor: 15 inches over bedrock.	Severe: very steep slopes.	Severe: very steep slopes; shallow to bedrock.
*Corlett: CoE, CpB------- For Hooper soils in CpB, refer to Hp under Hooper series.	Poor: very strongly alkaline sand.	Fair with washing and screening.	Unsuitable: no gravel.	Good: A-2.	Moderate to severe: water table at a depth of 3½ to more than 5 feet in places.	Severe: very strongly alkaline; water table at a depth of 3½ to more than 5 feet in places.
Costilla: CsA-----------	Poor: gravelly loamy sand.	Fair with washing and screening.	Poor: 15 to 35 percent gravel.	Good: A-2.	Slight: rapid permeability.	Slight---------
Cotopaxi: CtE-----------	Poor: sand---	Good----------	Unsuitable: no gravel.	Good: A-3.	Slight: rapid permeability.	Moderate to severe: 10 to 25 percent slopes.
Dune land: Du-----------	Poor: sand---	Good----------	Unsuitable: no gravel.	Good: A-3.	Severe: dunes.	Severe: shifting sand.
*Graypoint: GgA---------- For Gravelly land in this mapping unit, refer to Gravelly land.	Fair: gravelly sandy loam and sandy loam.	Good below a depth of 12 inches with washing and screening.	Good below a depth of 12 inches with washing and screening.	Good below a depth of 12 inches: A-1.	Slight-------	Slight---------
Gravelly land------------ Mapped only in complexes with Graypoint soils and with San Luis soils.	Poor: texture and low organic-matter content.	Fair with washing and screening.	Good with screening.	Good: A-1.	Slight-------	Slight---------

Soil features affecting--						Soil corrosivity	
Highway location	Dikes and diversions	Farm ponds: Reservoir area	Farm ponds: Embankment	Agricultural drainage	Irrigation	Untreated steel pipe	Concrete conduits
Very steep slopes; shallow soil.	Very steep slopes.	Very steep slopes; shallow over bedrock.	Very stony; shallow soils.	Not needed----	Very steep; stony soil; unsuitable for cultivation.	Low-------	Low.
Erodible slopes; fair stability; dune topography.	Erodible slopes; rapid permeability.	Rapid permeability.	Erodible slopes; rapid permeability.	Rapid permeability; dune topography.	Low available water holding capacity; very strongly alkaline; rapid permeability; dune topography.	Low to moderate.	Moderate.
Good stability; nearly level.	Good stability; rapid permeability.	Rapid permeability.	Good stability; rapid permeability.	Not needed----	Rapid permeability; very low available water holding capacity.	Low-------	Low.
Fair stability; erodible slopes; hilly topography.	Erodible slopes; fair stability; rapid permeability.	Rapid permeability.	Erodible slopes; rapid permeability; fair stability.	Not needed----	Very low available water holding capacity; rapid permeability.	Low-------	Low.
Erodible slopes; hilly topography.	Very rapid permeability.	Very rapid permeability.	Very rapid permeability.	Not needed----	Not applicable.	Low-------	Low.
Good stability.	Very rapid permeability below a depth of 12 inches; good stability.	Gravel below a depth of 12 inches; very rapid permeability.	Very rapid permeability; gravel below a depth of 12 inches.	Not needed----	Very low available water holding capacity; moderately rapid water intake rate; gravel at a depth of about 12 inches.	Low-------	Low.
Good stability.	Very rapid permeability; good stability.	Very rapid permeability; high seepage.	Very rapid permeability; good stability.	Not needed----	Very low available water holding capacity; shallow over gravel; poor farming land.	Low------	Low.

Series and map symbols	Suitability as a source of-- Topsoil	Sand	Gravel	Road fill	Limitations for-- Septic tank filter fields	Homesites
Gunbarrel:						
Gn	Poor: loamy coarse sand.	Fair to poor with washing and screening: 15 to 30 percent fines.	Unsuitable: less than 10 percent gravel.	Good: A-2.	Severe: water table at a depth of 2 to 4 feet.	Moderate: water table at a depth of 2 to 4 feet.
Gs	Poor: texture; less than 1 percent organic-matter content.	Fair to poor with washing and screening; 15 to 30 percent fines.	Unsuitable: less than 10 percent gravel.	Good: A-2.	Unsuitable: water table at a depth of 1 to 3 feet.	Severe: water table at a depth of 1 to 3 feet.
Hapney: Ha	Poor: alkali; moderately to very strongly alkaline.	Fair below a depth of 40 inches with washing and screening.	Unsuitable: no gravel.	Fair to a depth of 40 inches: A-6. Good below a depth of 40 inches: A-1 or A-3.	Severe: slow permeability.	Moderate: moderate shrink-swell potential.
Homelake: Hm	Good	Fair below a depth of 40 inches.	Unsuitable: less than 10 percent gravel.	Good below a depth of 40 inches: A-1 or A-3.	Severe: water table at a depth of 2 to $3\frac{1}{2}$ feet; overflow hazard.	Severe to moderate: water table at a depth of 2 to $3\frac{1}{2}$ feet; overflow hazard.
Hooper:						
Ho	Poor: low organic-matter content; alkali.	Fair below a depth of 36 inches with washing and screening.	Unsuitable: less than 10 percent gravel.	Poor in subsoil: A-6 or A-7. Good in substratum: A-2.	Moderate: water table at a depth of 4 to more than 5 feet.	Severe: moderate to high shrink-swell potential; alkali.
Hp	Unsuitable: alkali.	Fair below a depth of 36 inches with washing and screening.	Unsuitable: less than 10 percent gravel.	Poor in surface layer and subsoil: A-6 or A-7. Good in substratum: A-2.	Slight to moderate: fluctuating water table.	Severe: alkali; moderate to high shrink-swell potential.

Soil features affecting--						Soil corrosivity	
Highway location	Dikes and diversions	Farm ponds		Agricultural drainage	Irrigation	Untreated steel pipe	Concrete conduits
		Reservoir area	Embankment				
Good stability; moderately high water table; high frost hazard.	Rapid permeability; good stability.	Rapid permeability; rapid seepage unless sealed.	Good stability; rapid permeability.	Moderately high water table; rapid permeability; nearly level.	Low available water holding capacity; highly erodible; nearly level.	Moderate--	Low.
Good stability; high water table; high frost hazard.	Rapid permeability; good stability.	Rapid permeability; rapid seepage unless sealed.	Good stability; rapid permeability.	High water table; rapid permeability; nearly level.	Poorly drained; low available water holding capacity.	High------	Low.
High sodium content; frost hazard.	Fair stability.	Slow permeability; slow seepage.	Slow permeability; cracks when dry.	Slow permeability in subsoil; sand substratum; nearly level.	Slow permeability; moderate available water holding capacity; alkali; nearly level.	Moderate--	Moderate.
Subject to overflow.	Moderate permeability; good stability.	Moderate permeability.	Moderate permeability; good stability.	Not needed----	High available water holding capacity; nearly level; moderate permeability.	Low-------	Low.
Alkali; moderate to high shrink-swell potential.	Very slow permeability; sandy surface layer; good stability.	Very slow permeability; slow seepage.	Good stability; very slow permeability.	High sodium content; alkali; very slow permeability; nearly level.	Very slow permeability; high sodium content; alkali; nearly level.	High------	Moderate.
High sodium content; alkali.	Very slow permeability; fair stability.	Very slow permeability; slow seepage.	Fair stability; very slow permeability; high sodium content; alkali; cracks when dry.	High sodium content; alkali; very slow permeability; nearly level.	Very slow permeability; high sodium content; alkali; nearly level.	High------	Moderate.

Series and map symbols	Suitability as a source of-- Topsoil	Sand	Gravel	Road fill	Limitation for-- Septic tank filter fields	Homesites
Hooper: (Continued) Hs	Unsuitable: alkali and salts.	Unsuitable in upper 3 feet: clay loam or clay.	Unsuitable: no gravel.	Poor to unsuitable in upper 3 feet: A-6 or A-7.	Unsuitable: water table at a depth of 2 to 3 feet; flood hazard.	Severe: water table at a depth of 2 to 3 feet; salts and alkali.
LaJara: La	Good	Fair below a depth of 50 inches.	Unsuitable: no gravel.	Fair to a depth of 50 inches. Good at a depth below 50 inches.	Severe: flood hazard; fluctuating water table.	Severe: water table at a depth of 1½ to 2½ feet; poor drainage.
Laney: Le	Poor: salts and alkali.	Unsuitable: more than 50 percent fines.	Unsuitable: no gravel.	Fair: A-2 and A-4.	Slight	Moderate: moderate shrink-swell potential.
LaSauses: Ls	Poor: salts and alkali.	Unsuitable: more than 50 percent fines.	Unsuitable: no gravel.	Poor: A-6 and A-7.	Severe: very slow permeability; high water table.	Severe: poorly drained; high water table.
Littlebear: LtC	Poor: organic-matter content less than 1 percent; alkali.	Fair below a depth of 23 inches with washing and screening; 10 to 25 percent fines.	Unsuitable: less than 20 percent gravel.	Good to fair: A-4 or A-2.	Slight	Moderate: pH 7.9 to 10.0; alkali.

Soil features affecting--							Soil corrosivity	
Highway location	Dikes and diversions	Farm ponds: Reservoir area	Farm ponds: Embankment	Agricultural drainage	Irrigation	Untreated steel pipe	Concrete conduits
Subject to flooding; high water table; poor stability.	Very slow permeability; poor stability; high water table.	Very slow permeability.	Very slow permeability.	Not feasible--	Not feasible--	High------	High.
Subject to overflow; high water table.	Moderate permeability; fair stability.	Moderate permeability.	Moderate permeability; good stability.	Outlets difficult to find.	Moderate permeability; nearly level; drainage needed; subject to overflow.	Low to moderate.	Low.
High sodium content; alkali.	High sodium content; alkali; moderate permeability.	Moderate permeability.	Moderate permeability; high sodium content; alkali; erodible slopes; fair stability.	High sodium content; alkali; moderate permeability.	Moderate permeability; high sodium content; alkali; nearly level.	High------	Low.
Low stability; high water table; high frost hazard.	Very slow permeability; high salt content; high water table; low stability.	Very slow permeability; slow seepage.	Very slow permeability; low stability; cracks when dry.	Poorly drained; high salt content; very slow permeability.	Needs drainage and leaching; very slow permeability.	High------	High.
Good stability; erodible slopes.	Good stability; erodible slopes.	Moderately rapid permeability; rapid seepage.	Good stability; erodible slopes; moderately rapid permeability.	Not needed----	Moderately rapid permeability; low available water holding capacity; moderately steep slopes; water erosion may be a problem.	Moderate to high.	Moderate.

Series and map symbols	Suitability as a source of-- Topsoil	Sand	Gravel	Road fill	Limitation for-- Septic tank filter fields	Homesites
Loamy alluvial land: Lu	Fair to poor: slight to moderate salinity.	Fair below a depth of 36 inches with washing and screening.	Unsuitable: less than 10 percent gravel.	Fair to a depth of 36 inches: A-6. Good at a depth below 36 inches: A-2.	Severe: water table at a depth of $1\frac{1}{2}$ to 3 feet in places.	Severe: high water table in places.
Marsh: Ma. Too variable to be rated.						
McGinty: Mc	Good	Poor: 30 to 45 percent fines.	Unsuitable: less than 5 percent gravel.	Good: A-2.	Slight	Slight
Mg	Poor: slight to moderate salinity.	Poor: 30 to 45 percent fines.	Unsuitable: less than 5 percent gravel.	Good: A-2.	Severe: water table at a depth of 2 to 3 feet.	Severe: water table at a depth of 2 to 3 feet.
Medano: Mn	Fair to good: somewhat poorly drained.	Fair with washing and screening; depth of overburden; 5 to 15 percent fines.	Unsuitable: no gravel.	Good: A-2 and A-3.	Severe: water table at a depth of 1 to 2 feet.	Severe: water table at a depth of 1 to 2 feet.
Mosca: Mo	Poor: texture; salinity and alkali.	Good to fair below a depth of 36 inches with washing and screening; 5 to 15 percent fines.	Unsuitable: less than 10 percent gravel.	Good: A-2 or A-3.	Slight	Slight

Soil features affecting--						Soil corrosivity	
Highway location	Dikes and diversions	Farm ponds: Reservoir area	Farm ponds: Embankment	Agricultural drainage	Irrigation	Untreated steel pipe	Concrete conduits
Low bottom land; good stability.	Moderate to moderately slow permeability.	Moderate to moderately slow permeability.	Good stability; cracks when dry.	Nearly level; outlets may be difficult to find; moderate to moderately slow permeability.	High available water holding capacity.	High------	Moderate.
Good stability.	Good stability; moderately rapid permeability.	Moderately rapid permeability.	Good stability; moderately rapid permeability.	Moderately rapid permeability;	Moderate available water holding capacity; nearly level.	Low to moderate.	Low.
Good stability; high frost hazard.	Moderately rapid permeability; good stability.	Moderately rapid permeability.	Moderately rapid permeability; good stability.	High water table; slight to moderate salinity; nearly level.	Moderately rapid permeability; moderate to low available water holding capacity; high water table; nearly level.	High------	Low.
Moderate stability; high water table; nearly level.	Rapid permeability; moderate stability.	Rapid permeability; rapid seepage unless sealed.	Rapid permeability; moderate stability.	High water table; surface drainage needed in places; nearly level.	Rapid permeability; nearly level; high water table; low available water holding capacity.	Moderate--	Low.
Good stability; frost hazard.	Moderately rapid permeability; good stability.	Moderately rapid permeability; rapid seepage unless sealed.	Good stability; moderately rapid permeability.	Moderately rapid permeability; nearly level.	Low available water holding capacity; highly erodible; nearly level.	Low to moderate.	Moderate.

Series and map symbols	Suitability as a source of-- Topsoil	Sand	Gravel	Road fill	Limitation for-- Septic tank filter fields	Homesites
Mosca: (Continued)						
Ms--------------------	Poor: texture; salinity and alkali.	Good to fair below a depth of 36 inches with washing and screening; 5 to 15 percent fines.	Unsuitable: less than 10 percent gravel.	Good: A-2 or A-3.	Severe: water table at a depth of 2 to 3 feet.	Severe: water table at a depth of 2 to 3 feet.
*Mount Home: MtD-------- For Saguache soils in this mapping unit, refer to the Saguache series.	Poor: 75 to 95 percent cobblestones, stones, and gravel.	Poor: 75 to 95 percent cobblestones, stones, and gravel.	Poor: 20 to 30 percent gravel.	Good: A-1.	Slight: moderately rapid permeability.	Moderate; 4 to 12 percent slopes.
Nortonville: No--------	Poor: salts and alkali.	Unsuitable: more than 50 percent fines.	Unsuitable: no gravel.	Fair: A-4 and A-6.	Severe: water table at a depth of 2 to 3 feet.	Severe: water table at a depth of 2 to 3 feet.
Peat: Pe. Too variable to be rated.						
Saguache---------------- Mapped only in a complex with Mount Home soils.	Poor: 60 to 80 percent gravel and cobblestones.	Fair below a depth of 10 inches with washing and screening.	Good below a depth of 10 inches with washing and screening.	Good below a depth of 10 inches: A-1.	Slight: very rapid permeability.	Slight: excessively drained.
San Arcacio:						
Sa--------------------	Good-----------	Good below a depth of 17 inches with washing and screening.	Good below a depth of 17 inches; 0 to 10 percent fines.	Good below a depth of 17 inches: A-1.	Moderate to severe: water table at a depth of 3 to 4 feet.	Moderate: water table at a depth of 3 to 4 feet.
Sc--------------------	Poor: salts---	Good below a depth of 17 inches with washing and screening.	Good below a depth of 17 inches; 0 to 10 percent fines.	Good below a depth of 17 inches: A-1.	Unsuitable: water table at a depth of 1 to 3 feet.	Severe: salts; water table at a depth of 1 to 3 feet.

Soil features affecting--						Soil corrosivity	
Highway location	Dikes and diversions	Farm ponds: Reservoir area	Farm ponds: Embankment	Agricultural drainage	Irrigation	Untreated steel pipe	Concrete conduits
Good stability; high water table; high frost hazard.	Moderately rapid permeability; good stability.	Moderately rapid permeability; rapid seepage unless sealed.	Good stability; moderately rapid permeability.	High water table; moderately rapid permeability; nearly level.	Low available water holding capacity; high water table.	High------	Moderate.
Good stability.	Moderately rapid permeability; cobbly soil; good stability.	Moderately rapid permeability; rapid seepage.	Moderately rapid permeability; cobbly soil.	Not needed---	Cobbly; very low available water holding capacity; poor farming soil.	Low-------	Low.
High stability; high water table; high frost hazard; nearly level.	Moderately slow permeability; high stability.	Moderately slow permeability.	Moderately slow permeability; good stability.	Moderate to strong salt content; moderately slow permeability.	High available water holding capacity; high water table; moderate to high salinity.	High------	Moderate.
Good stability.	Very rapid permeability; good stability.	Very rapid permeability; rapid seepage.	Very rapid permeability.	Not needed---	Very low available water holding capacity; 4 to 12 percent slopes.	Low-------	Low.
Good stability.	Good stability; rapid seepage.	Gravel below a depth of 17 inches; rapid seepage unless sealed.	Good stability; gravel and sand layer has very rapid permeability.	Not needed---	Low available water holding capacity; moderately shallow over gravel.	Moderate--	Low.
Good stability; high water table; high frost hazard.	Very rapid permeability below a depth of 17 inches; good stability.	Gravel below a depth of 17 inches; rapid seepage unless sealed.	Good stability; gravel has very rapid permeability.	Very rapid permeability below a depth of 17 inches.	Poor drainage; low available water holding capacity; high salinity.	High------	Low.

Series and map symbols	Suitability as a source of-- Topsoil	Sand	Gravel	Road fill	Limitation for-- Septic tank filter fields	Homesites
Sandy Alluvial land: Sd--	Poor: texture; low organic-matter content.	Good in selected areas if screened and washed.	Good in selected areas if screened and washed.	Good: A-1 and A-2.	Severe: subject to flooding and ground-water pollution.	Severe: fluctuating water table; subject to flooding.
*San Luis:						
Se, SlB, Sm------------- For Corlett soils in SlB, refer to the Corlett series. For Gravelly land in Sm, refer to Gravelly land.	Poor: low organic-matter content; salts and alkali.	Fair below a depth of 34 inches with washing and screening; 5 to 20 percent fines.	Unsuitable: no gravel.	Fair to a depth of 34 inches: A-4 or A-6. Good in substratum at a depth below 34 inches: A-2 or A-3.	Severe to unsuitable; water table at a depth of 1 to 3 feet; moderately slow permeability.	Severe: water table at a depth of 1 to 3 feet.
Sf----------------------	Fair: low organic-matter content.	Fair below a depth of 34 inches with washing and screening; 5 to 20 percent fines.	Unsuitable: no gravel.	Fair to a depth of 34 inches: A-4 or A-6. Good in substratum at a depth below 34 inches: A-2 or A-3.	Severe: water table at a depth of 3 to 4 feet; moderately slow permeability.	Moderate: water table at a depth of 3 to 4 feet.
*Space City:						
SpB, StE---------------- For Hooper part of StE, refer to Ho under Hooper series.	Poor: coarse texture; low organic-matter content.	Fair with washing; 15 to 25 percent fines.	Unsuitable: no gravel.	Fair: SM.	Slight---------	Slight---------
SrB---------------------	Poor: coarse texture; low organic-matter content.	Fair with washing; 15 to 25 percent fines.	Unsuitable: no gravel.	Fair: SM.	Slight---------	Moderate: high alkali content below a depth of 24 inches.

Soil features affecting--						Soil corrosivity	
Highway location	Dikes and diversions	Farm ponds: Reservoir area	Farm ponds: Embankment	Agricultural drainage	Irrigation	Untreated steel pipe	Concrete conduits
Subject to flooding; good stability.	Moderately rapid to very rapid permeability; good stability.	Moderately rapid to very rapid permeability; rapid seepage.	Moderately rapid to very rapid permeability.	Not needed-----	Subject to overflow; very low available water holding capacity.	Low-------	Low.
Poor drainage; good stability; high water table; high frost hazard.	High water table; good stability.	Slow seepage when compacted; high water table.	Good stability; high water table; salts and alkali.	High water table; outlets may be difficult to find; sand substratum.	Poorly drained; high water table; salts and alkali.	High------	Moderate.
Good stability; high frost hazard.	Good stability; moderately slow permeability.	Slow seepage when compacted.	Good stability; moderately slow permeability.	Subsoil has moderately slow permeability; sand substratum.	Slight saline; nearly level; high available water holding capacity.	Moderate to high.	Moderate.
Erodible slopes; fair stability.	Erodible slopes; rapid permeability.	Rapid permeability.	Erodible slopes; rapid permeability; fair stability.	Not needed-----	Low available water holding capacity; rapid permeability.	Low-------	Low.
Erodible slopes; fair stability.	Erodible slopes; rapid permeability.	Rapid permeability.	Erodible slopes; rapid permeability.	Rapid permeability.	Low available water holding capacity; rapid permeability.	High------	Moderate

Series and map symbols	Suitability as a source of-- Topsoil	Sand	Gravel	Road fill	Limitation for-- Septic tank filter fields	Homesites
Uracca: UrF	Poor: very cobbly.	Unsuitable: texture; content of cobblestones.	Unsuitable: texture; content of cobblestones.	Good below a depth of 9 inches: A-1.	Severe: moderately steep.	Severe: moderately steep.
Vastine: Va	Fair: poor drainage.	Substratum fair with washing and screening.	Unsuitable: no gravel.	Fair to poor: A-4 or A-6. Good below a depth of 30 inches: A-1 or A-2.	Severe: flood hazard; high water table at a depth of 1 to 2 feet.	Severe: flood hazard; high water table at a depth of 1 to 2 feet.
Villa Grove: VgA	Fair: sandy clay loam.	Unsuitable: clay loam.	Unsuitable: no gravel.	Fair: A-6.	Severe: moderately slow permeability.	Moderate: moderate shrink-swell potential.
VlA, VlB	Poor: salt content.	Unsuitable: clay loam.	Unsuitable: no gravel.	Fair: A-6.	Severe to moderate: high water table at a depth of 2 to 4 feet.	Severe to moderate: salinity; high water table at a depth of 2 to 4 feet.
Wet alluvial land: Wa	Poor: salts and alkali.	Fair to good below a depth of 36 inches with washing and screening; 5 to 15 percent fines.	Unsuitable: no gravel.	Fair below a depth of 36 inches.	Severe: water table at a depth of 1 to 2 feet; subject to flooding.	Severe: water table at a depth of 1 to 2 feet; subject to flooding.
Zinzer: ZnA, ZnB	Good	Unsuitable: loam.	Unsuitable: no gravel.	Fair: A-6.	Moderate: moderate permeability.	Slight

Soil features affecting--						Soil corrosivity	
Highway location	Dikes and diversions	Farm ponds		Agricultural drainage	Irrigation	Untreated steel pipe	Concrete conduits
		Reservoir area	Embankment				
Moderately steep; very cobbly.	Rapid permeability below the subsoil; very cobbly.	Moderately steep slopes; rapid permeability below subsoil; rapid seepage.	Rapid permeability below the subsoil; very cobbly.	Not needed-----	Moderately steep; very cobbly.	Low--------	Low.
Subject to overflow; high water table; good stability.	Moderate to moderately slow permeability.	Moderate to moderately slow permeability.	Moderate to moderately slow permeability.	Subject to overflow; surface drainage needed; high water table; nearly level; outlets difficult to find.	Surface drainage needed; some salt spots; subject to overflow; nearly level.	High------	Moderate.
Nearly level--	Good stability; moderately slow permeability.	Slow seepage when compacted; moderately slow permeability.	Good stability; moderately slow permeability.	Moderately slow permeability.	High available water holding capacity; nearly level.	Low to moderate.	Low.
High water table; high frost hazard.	Good stability; moderately slow permeability.	Slow seepage--	Good stability; moderately slow permeability.	Poorly drained; moderately slow permeability; moderate to strong salinity.	High available water holding capacity; moderate to strong salinity; poor drainage.	High------	Low.
High water table; good stability.	Moderate to moderately slow permeability.	Moderate to moderately slow permeability.	Moderate to moderately slow permeability; good stability.	Nearly level; high water table; outlets may be difficult to find; moderate to moderately slow permeability.	High available water holding capacity; high water table; moderate to strong salinity.	High------	Moderate.
Good stability.	Good stability; moderate permeability.	Slow seepage when compacted; moderate permeability.	Good stability; moderate permeability.	Moderate permeability.	High available water holding capacity; nearly level.	Low to moderate.	Low.

Series and map symbols	Suitability as a source of--				Limitation for--	
	Topsoil	Sand	Gravel	Road fill	Septic tank filter fields	Homesites
Zinzer:						
ZoA---------------------	Poor: salts---	Unsuitable: loam.	Unsuitable: no gravel.	Fair: A-6.	Severe: high water table at a depth of 2 to 3 feet.	Severe: high water table at a depth of 2 to 3 feet.

ENGINEERING INTERPRETATIONS--Continued

Soil features affecting--						Soil corrosivity	
Highway location	Dikes and diversions	Farm ponds: Reservoir area	Farm ponds: Embankment	Agricultural drainage	Irrigation	Untreated steel pipe	Concrete conduits
Good stability; high water table; high frost hazard.	Good stability; moderate permeability.	Slow seepage when compacted.	Good stability; moderate permeability.	High water table; moderate permeability.	Poorly drained; high available water holding capacity; high salinity; nearly level.	High------	Low.

TABLE 7.--ENGINEERING TEST DATA FOR

[Tests performed by Soil Mechanics Laboratory, Soil

Soil name and location	Parent material	Laboratory sample No.	Depth	Mechanical analysis 1/ Percentage passing sieve-- 3/4 inch (19.0 mm.)	3/8 inch (9.5 mm.)	No. 4 (4.7 mm.)	No. 10 (2.0 mm.)
			Inches				
Cotopaxi sand: 400 feet north and 0.3 mile west of the southeast corner of section 36, T. 40 N., R. 12 E.	Eolian sand.	65C-50	8-60	---	---	---	100
Gunbarrel loamy sand: 0.1 mile east and 40 feet south of the north quarter corner of section 35, T. 40 N., R. 9 E.	Sandy alluvium.	65C-51	5-13	---	100	99	97
		65C-52	48-60	4/ 99	88	81	71
Hooper clay loam: 150 feet east and 20 feet south of the west quarter corner of section 31, T. 38 N., R. 9 E.	Clayey alluvium.	65C-59	7-12	---	---	---	100
		65C-60	32-60	---	100	99	94
LaJara loam: 550 feet east and 300 feet north of the southwest corner of section 14, T. 36 N., R. 10 E.	Alluvium.	65C-49	17-54	---	---	---	---
Laney loam: 1,700 feet south and 500 feet west of the northeast corner of section 8, T. 37 N., R. 12 E.	Alluvium.	65C-61	11-17	---	---	---	100
LaSauses sandy clay loam: 2,400 feet north of the southeast corner of section 9, T. 36 N., R. 10 E.	Clayey alluvium.	65C-62	4-11	---	---	---	100
		65C-63	15-45	---	---	---	100

See footnotes at end of table.

SOIL SAMPLES FROM NINE PROFILES

Conservation Service, Lincoln, Nebraska]

Mechanical analysis 1/--Continued							Liquid limit	Plasticity index	Classification	
Percentage passing sieve--Cont.			Percentage smaller than--						AASHO	Unified 2/
No. 40 (0.42 mm.)	No. 60 (0.250 mm.)	No. 200 (0.74 mm.)	0.05 mm.	0.02 mm.	0.005 mm.	0.002 mm.				
87	52	7	3	3	3	2	3/ NP	3/ NP	A-3(0)	SM-SP
73 44	57 31	21 10	13 3	11 2	8 2	8 2	NP NP	NP NP	A-2-4(0) A-1-b(0)	SM SM-SP
89 70	80 53	60 18	48 8	41 6	37 5	35 3	32 NP	14 NP	A-6(7) A-2-4(0)	CL SM
---	100	77	56	37	23	17	34	6	A-4(8)	ML
99	93	58	46	37	30	27	27	10	A-4(5)	CL
97 ---	94 ---	74 93	58 91	43 88	33 77	27 51	33 64	12 32	A-6(9) A-7-6(20)	CL MH

Soil name and location	Parent material	Laboratory sample No.	Depth	Mechanical analysis 1/			
				Percentage passing sieve--			
				3/4 inch (19.0 mm.)	3/8 inch (9.5 mm.)	No. 4 (4.7 mm.)	No. 10 (2.0 mm.)
Mosca loamy sand: 125 feet south and 1,320 feet west of the east quarter corner of section 34, T. 40 N., R. 9 E.	Sandy alluvium.	65C-53	0-3	100	99	98	95
		65C-54	5-10	---	---	---	100
San Luis sandy loam: 150 feet west and 630 feet south of the east quarter corner of section 27, T. 39 N., R. 9 E.	Alluvium.	65C-55	0-5	---	---	---	100
		65C-56	5-9	---	---	---	100
		65C-57	19-34	---	---	---	100
Zinzer loam: 600 feet north and 100 feet west of the east quarter corner of section 28, T. 37 N., R. 9 E.	Alluvium.	65C-58	12-23	100	97	95	89

1/ Mechanical analysis according to AASHO Designation T 88-57 (1). Results by this procedure may differ somewhat from results obtained by the soil survey procedure of the Soil Conservation Service (SCS). In the AASHO procedure, the fine material is analyzed by the hydrometer method, and the various grain-size fractions are calculated on the basis of all the material, including that coarser than 2 millimeters in diameter. In the SCS soil survey procedure, the fine material is analyzed by the pipette method, and the material coarser than 2 millimeters in diameter is excluded from calculations of grain-size fractions. The mechanical analysis data used in this table are not suitable for naming textural classes for soils.

Mechanical analysis 1/--Continued							Liquid limit	Plasticity index	Classification	
Percentage passing sieve--Cont.			Percentage smaller than--						AASHO	Unified 2/
No. 40 (0.42 mm.)	No. 60 (0.250 mm.)	No. 200 (0.74 mm.)	0.05 mm.	0.02 mm.	0.005 mm.	0.002 mm.				
64	50	16	8	6	6	3	3/ NP	3/ NP	A-2-4(0)	SM
79	67	31	18	14	14	14	NP	NP	A-2-4(0)	SM
86	67	36	29	25	19	16	18	0	A-4(0)	SM
84	71	43	30	25	20	17	30	12	A-6(2)	SC
73	65	50	39	32	23	17	30	12	A-6(4)	SC or CL
73	65	50	38	33	31	28	39	20	A-6(7)	SC or CL

2/ SCS and BPR have agreed to consider that all soils having plasticity indexes within two points from A-line are to be given a borderline classification. An example of borderline classification obtained by this use is SM-SP.

3/ Nonplastic.

4/ 100 percent passed the 1-inch sieve.

Engineering Test Data

Table 7 contains engineering test data for some of the major soil series in the Alamosa Area. These tests were made to help evaluate the soils for engineering purposes. The engineering classifications given are based on data obtained by mechanical analyses and by tests to determine liquid limits and plastic limits. The mechanical analyses were made by combined sieve and hydrometer methods.

Tests to determine liquid limit and plastic limit measure the effect of water on the consistence of soil material, as has been explained for table 5.

FORMATION, CLASSIFICATION, AND MORPHOLOGY OF THE SOILS 6/

This section presents the outstanding morphologic characteristics of the soils of the Alamosa Area and relates them to the factors of soil formation. The first part of the section deals with the environment of the soils; the second, with their classification; the third, with their morphology; and the fourth, with laboratory analysis of selected soils.

Factors of Soil Formation

Soil is produced by the action of soil-forming processes on parent material that was deposited or accumulated by geologic forces (5). The characteristics of the soil at any given point are determined by (1) the physical and mineralogical composition of the parent material, (2) the climate under which the soil material accumulated and weathered, (3) the plant and animal life on and in the soil, (4) the relief, or lay of the land, and (5) the length of time that the forces of soil formation have acted on the soil material.

Climate and plant and animal life, chiefly plants, are the active factors of soil formation. They act on the parent material that has accumulated through the weathering of rocks or has been deposited by wind and water and slowly change it to a natural body that has genetically related horizons. The effects of climate and plant and animal life are conditioned by relief. The parent material also affects the kind of profile that is formed and, in extreme cases, determines it almost entirely. Finally, time is needed for changing the parent material into a soil profile. It may be much or little, but some time is always required for the development of distinct horizons.

The factors of soil formation are so closely interrelated in their effects on the soil that few generalizations can be made regarding the effect of any one factor unless conditions are specified for the other four. The factors of soil formation are not equal in their effect on soil formation, nor is any one factor equal under different conditions. In some places any one factor may exert a major influence on soil formation, while in another place it may be of little importance. For example, relief has little effect and parent material has much effect on soil formation in sandhills under semi-arid conditions. Many of the processes of soil formation are unknown.

Parent Material

Parent material affects soil formation in many ways. It determines largely the texture, structure, consistence, color, and arrangement of horizons. It affects the rate of soil formation by its ease or resistance to weathering. It also has such effects on the soil as fertility and erodibility. The soils of the Alamosa Area formed in three major kinds of parent material: (1) eolian sandy deposits, (2) alluvium, and (3) granite rocks of Precambrian age.

The soils that formed in eolian sandy deposits make up about 77,000 acres of the survey area. These are the Cotopaxi, Corlett, and Space City soils and Dune land. They are mostly in the northeastern and eastern parts of the survey area. The parent material consists mostly of fine and medium sand. It is of mixed composition in most areas because of its origin. The material originated in the mountains surrounding the valley; hence, part of it is quartzitic and part is from basaltic or basic rocks. This material is brought into the valley by streams and then is transported by wind to be deposited in sand dunes. The large areas of dunes are located in the northeastern part of the survey area because the prevailing winds are from the southwest. The winds carry the sand across the valley floor until they lose velocity in rising over the Sangre de Cristo Mountain Range. Here, most of the sand is deposited (8).

There are small sand dunes throughout the central part of the survey area, but these dunes are not so high as the ones farther to the east, and they are interspersed with soils from alluvial material. This sandy material is resistant to weathering and normally is not in place long enough for major soil horizons to form.

The soils that formed in alluvial material make up by far the greatest part of the survey area. There is a wide range in the character of this material, depending largely on its source, distance from the source, and the relief. The Alamosa, Arena, Homelake, LaJara, Nortonville, and Vastine soils formed in medium-textured or moderately fine textured materials that have been deposited by the Rio Grande River and Alamosa, LaJara, and Rock Creeks.

6/ ARVAD J. CLINE, senior soil correlator, Soil Conservation Service, Fort Collins, Colorado, assisted in the preparation of this section.

The parent material deposited by these streams was brought from areas that contain large amounts of volcanic rocks, chiefly of quartz latite, andesite, basalt, and rhyolite composition. The LaSauses soils formed in fine-textured alluvium from the same source (15, 20).

The Acacio, Villa Grove, and Zinzer soils formed in medium-textured and moderately fine textured alluvial material on the drainageways of LaJara, Alamosa, and Rock Creeks. This alluvial material originated from the weathering of volcanic rocks, principally of quartz latite and rhyodacite composition. Gypsum occurs in these soils in large amounts in some places and probably was derived from sulfides and sulfates in the volcanic rocks.

The Gunbarrel, McGinty, and Mosca soils formed in moderately coarse textured and coarse textured alluvium on the Rio Grande fan or flood plain in the northwestern part of the survey area. The parent material was derived largely from rhyolite or latite.

The Arena, Hapney, Hooper, and Laney soils formed in medium-textured and moderately fine textured alluvium in the central part of the survey area. The large amount of salts and alkali in some of these soils is probably related to the composition of the parent materials.

The Costilla, Mount Home, Saguache, and Uracca soils formed in coarse-textured alluvial material on the fans from the Sangre de Cristo Mountains. This material was derived from granite, gneiss, and related Precambrian rocks (21). The upper ends of these fans consist mostly of cobblestones and rocks, but the lower ends are gravel and sand.

The only soil forming on bedrock is the Commodore soil, which occurs on the very steep sides of the Sangre de Cristo Mountains. The parent material was derived from granitic rocks of Precambrian age. This material is resistant to weathering.

Climate

Climate influences the physical and chemical weathering of parent material and affects the rate of biological activity. Soil temperature and moisture are the main factors; however, such factors as wind velocities and humidity have a significant influence on soil climate. Generally, soil-forming processes are more active when temperatures are warm and moisture is adequate but not excessive. The high water table that exists in part of the survey area has a profound effect on soil climate and, in the areas of its occurrence, creates soil climates that are not normal for the area as a whole.

The climate of the Alamosa Area is a cold, dry, mountain valley climate with cool summers and cold winters. The average annual temperature at Alamosa is about 41° F., the average summer temperature is about 62°, and the average annual precipitation is 6.7 inches. Precipitation is slightly higher, about 10 to 12 inches, on the slopes of the Sangre de Cristo Mountains. The average snowfall is about 30 inches at Alamosa.

Moisture moving downward through the soil influences soil formation by leaching calcium carbonate and other soluble salts out of the surface horizon and depositing them in the B or C horizon and by transporting finely divided clay particles from upper to lower horizons. Thus, the low amount of rainfall in the survey area is reflected in the lack of soil formation in such soils as the Costilla, Laney, and Gunbarrel and by the thin solum of such soils as the Acacio and San Luis. Most of the soils that are not sandy are calcareous at or near the surface, indicating that leaching has been slow. Such sandy soils as the Cotopaxi and Space City, through which soil moisture moves rapidly, have had carbonates leached to a greater depth.

The supply of soil moisture also influences soil formation indirectly by controlling the amount and type of vegetation and, subsequently, the amount of organic matter returned to the soil. In the Alamosa Area, where soil moisture is limited, vegetative growth is sparse and yearly amounts of organic matter returned to the soil are small. Consequently, the soils are relatively low in organic-matter content.

In the areas where the water table is close to the soil surface for part of each year, the normal downward movement of moisture through the soil has been restricted. In some places the procedure has been reversed, and salts carried in solution by ground water have been precipitated within the soil. Horizons that have a strong accumulation of salts are not unusual in the soils of such areas.

Plant and Animal Life

Plants, micro-organisms, earthworms, and other forms of plant and animal life are on or in the soil and influence soil formation. The kinds of plant cover and micro-organisms growing at any location are controlled mainly by soil temperature, soil moisture supply, and the physical and chemical character of the parent material. In the Alamosa Area, soil moisture is the greatest limiting factor on well-drained sites.

Most of the soils in the Alamosa Area formed under a cover of shrubs and grasses. Because the vegetation is thin, there is little plant material returned to the soil and the organic-matter content is low. In the more poorly drained areas, the supply of soil moisture is greater and the soils formed under a dense cover of sedges, rushes, and water-tolerant grasses. These soils are high in organic-matter content, and the organic matter extends to a greater depth.

Soil micro-organisms affect soil formation in many ways. One of their most important functions is the breakdown of plant residue. In the Alamosa Area, these processes proceed rapidly in the well-drained soils so long as soil temperature is favorable and moisture supplies are adequate. Because soil moisture in summer generally depends on small infrequent showers, the activity of soil micro-organisms also fluctuates greatly during this period,

reaching a maximum after each shower and decreasing during the intervening dry periods.

Even though microbiologic activity assumes a sporadic pattern, it is sufficiently active to account for the thorough breakdown of the small yearly supply of plant residue returned to the soil in the survey area. Consequently, the well-drained soils are characterized by a low organic-matter content, highly stable forms of residual organic compounds, and distribution patterns in which organic matter is concentrated in the upper few inches of the profile. The maximum amount of organic matter coincides with the greatest concentration of plant roots.

In soils where the water table keeps the soil moist for a longer period of time, microbiologic life proceeds more uniformly throughout the warm seasons. In these areas, vegetation is more luxuriant and greater amounts of plant residue are returned to the soil yearly. Consequently, there is greater accumulation of the products of organic decomposition, and they are distributed throughout a greater depth of soil. Such soils are darker colored to a greater depth than well-drained soils

In some very poorly drained areas where the soil is wet most of the time, microbiologic life is dominantly anaerobic. Under such conditions, decomposition is often incomplete and undecomposed organic matter may accumulate on the soil surface.

Relief

Relief is a soil-forming factor that modifies the effects of climate and vegetation chiefly by controlling the amount of runoff and the degree of soil drainage. Most of the soils of the Alamosa Area are nearly level and have restricted subsurface drainage. Relief affects soil drainage, which, in turn, affects plant cover and microbial activity. Periodic poor drainage affects the processes of soil formation. For example, oxidation and reduction take place alternately in the LaSauses soils and result in a strongly mottled soil.

On steep soils, where runoff is rapid, geologic erosion commonly keeps up with soil formation. Under these conditions, genetic horizons may never form because the mechanical removal of soil may keep pace with the alteration of parent sediments.

Time

Time, or age, refers to the length of time the processes of soil formation have been active. Other conditions being equal, older soils normally have more distinct genetic horizons than younger soils. Older soils, such as the Uracca and Villa Grove soils, have a B horizon of clay enrichment and horizons of calcium carbonate accumulation. Younger soils do not have these horizons; they generally have an A, C or an A, C, R sequence of horizons. The Gunbarrel, Comodore, and Cotopaxi soils are young soils in the Alamosa Area. Soils of flood plains that are still receiving frequent increments of deposition may have differences between horizons. They are considered young soils because the differences are not genetic but are normal characteristics of the unaltered, stratified parent material.

A distinction must be made between chronologic age of landscapes and the age of a soil as interpreted from the degree of genetic horizon formation. Focal points of normal geologic erosion in many landscapes may have little or no formation of genetic horizons because of the removal of soil as rapidly as it is formed. Chronologically, such areas may be as old as those where the soils have well-formed genetic horizons.

Classification of Soils

Soils are classified so that we may more easily remember their significant characteristics, assemble knowledge about them, see their relationships to one another and to the whole environment, and develop principles that help us to understand their behavior and response to manipulation. First through classification, and then through use of soil maps, we can apply our knowledge of soils to specific fields and other tracts of land. The current system of classification (14, 15) defines classes in terms of observable or measurable properties of soils. The properties chosen as a basis for classification are primarily those that permit grouping soils that are similar in genesis. Genesis, or soil origin, does not appear in the definition of the classes; it lies behind the classes. The classification is designed to accommodate all soils. It employs a unique nomenclature that is both connotative and distinctive.

The current classification has six categories. Beginning with the most inclusive, the categories are the order, suborder, great group, subgroup, family, and series. In table 8 the soils of the Alamosa Area are placed in some of these categories and also in great soil groups of the 1938 classification. Following are brief descriptions of each of the six categories in the current system.

ORDER: Ten soil orders are recognized in the current system. They are Entisols, Vertisols, Inceptisols, Aridisols, Mollisols, Spodosols, Alfisols, Ultisols, Oxisols, and Histosols. The properties used to differentiate the soil orders are those that tend to give broad climatic groupings of soils. Two exceptions, Entisols and Histosols, occur in many different climates. Four orders are recognized in the Alamosa Area, Entisols, Inceptisols, Aridisols, and Mollisols.

Entisols are recent soils. They do not have natural genetic horizons or have only the beginnings of such horizons. In the Alamosa Area, this order includes soils previously classified as Alluvial soils or Regosols.

Inceptisols are soils that have one or more of the diagnostic horizons that are thought to form rather quickly. They do not have a spodic, argillic,

TABLE 8.--CLASSIFICATION OF SOILS

Series	Family	Subgroup	Order	Great soil group (1938 classification) (17)
Acacio	Fine-loamy, mixed, frigid	Typic Haplargids	Aridisols	Gypsosols.
Alamosa	Fine-loamy, mixed, noncalcareous, frigid.	Typic Argiaquolls	Mollisols	Chernozem-Humic Gley soils.
Arena	Fine-loamy, mixed, frigid	Aquentic Durorthids	Aridisols	Regosols.
Comodore	Loamy-skeletal, mixed	Lithic Haploborolls	Mollisols	Lithosols.
Corlett	Mixed, frigid	Typic Torripsamments	Entisols	Regosols.
Costilla	Mixed, frigid	Typic Torripsamments	Entisols	Regosols.
Cotopaxi	Mixed, frigid	Typic Torripsamments	Entisols	Regosols.
Graypoint	Fine-loamy over sand or sandy-skeletal, mixed, frigid.	Typic Haplargids	Aridisols	Brown soils.
Gunbarrel	Mixed, frigid	Typic Psammaquents	Entisols	Alluvial soils.
Hapney	Fine, montmorillonitic	Aridic Natriborolls	Mollisols	Solonetz soils.
Homelake	Fine-loamy, mixed	Aquic Fluvaquentic Haploborolls.	Mollisols	Alluvial soils.
Hooper	Clayey over sand or sandy-skeletal, montmorillonitic, frigid.	Typic Natrargids	Aridisols	Solonetz soils.
LaJara	Coarse-loamy, mixed, calcareous, frigid.	Typic Haplaquolls	Mollisols	Regosols.
Laney	Fine-loamy, mixed, calcareous, frigid.	Typic Torrifluvents	Entisols	Regosols.
LaSauses	Fine, mixed, nonacid, frigid	Aeric Halaquepts	Inceptisols	Regosols.
Littlebear	Sandy, mixed, frigid	Typic Torriorthents	Entisols	Alkali Regosols.
McGinty	Coarse-loamy, mixed, frigid	Typic Calciorthids	Aridisols	Calcisols.
Medano	Sandy, mixed, frigid	Typic Haplaquolls	Mollisols	Alluvial soils.
Mosca	Coarse-loamy, mixed, frigid	Typic Natrargids	Aridisols	Brown soils.
Mount Home	Loamy-skeletal, mixed, calcareous, frigid.	Typic Torriorthents	Entisols	Regosols.
Nortonville	Fine-loamy, mixed, frigid	Typic Calciaquolls	Mollisols	Regosols.
Saguache	Sandy-skeletal, mixed, frigid	Typic Torriorthents	Entisols	Regosols.
San Arcacio	Fine-loamy over sand or sandy-skeletal, mixed, frigid.	Typic Haplargids	Aridisols	Brown soils.
San Luis	Fine-loamy over sand or sandy-skeletal, mixed, frigid.	Aquic Natrargids	Aridisols	Brown soils.
Space City	Mixed, frigid	Typic Torripsamments	Entisols	Regosols.
Uracca	Loamy-skeletal, mixed	Aridic Argiborolls	Mollisols	Chestnut soils.
Vastine	Fine-loamy over sand or sandy-skeletal, mixed, noncalcareous, frigid.	Typic Haplaquolls	Mollisols	Alluvial soils.
Villa Grove	Fine-loamy, mixed	Aridic Argiborolls	Mollisols	Brown soils.
Zinzer	Fine-loamy, mixed	Aridic Calciborolls	Mollisols	Regosols.

or oxic horizon unless it is a buried horizon. They do not have a calcic or gypsic horizon within a depth of 40 inches. In the Alamosa Area, this order includes soils formerly classified as poorly drained Alluvial soils or Regosols.

Aridisols are soils of dry areas. They have a light-colored surface layer and a zone of translocated carbonates in a subsoil horizon. They may or may not have an argillic, calcic, gypsic, natric, or cambic horizon or a duripan. In the Alamosa Area, this order includes some of the soils that were formerly classified as Brown soils, Calcisols, Gypsosols, and Solonetz soils.

Mollisols are soils that have a thick, dark-colored surface layer. They may have an albic, cambic, argillic, or natric horizon; a duripan; or a ca, cs, or sa horizon. The climate of the Mollisols ranges from semi-arid to humid. The Mollisols in the Alamosa Area include some of the soils that formerly were classified as Chernozems, Chestnut soils, Humic Gley soils, Lithosols, and Solonetz soils. Some soils formerly classified as Regosols and Alluvial soils are now placed in the Mollisols.

SUBORDER: Each order has been subdivided into suborders, primarily on the basis of those soil characteristics that seem to produce classes that have the greatest genetic similarity. The suborders narrow the broad climatic range permitted in the orders. The soil properties used to separate suborders are mainly those that reflect either soil differences that result from climate or vegetation or the presence or absence of waterlogging or differences in parent material. The names of the suborders have two syllables. The last syllable indicates the order. An example is Psamments (Psamm, meaning sandy, and ent, from Entisol).

GREAT GROUP: Suborders are divided into great groups on the basis of uniformity in the kinds and sequence of major soil horizons and features. The horizons used to make separations are those in which clay, iron, or humus has accumulated or those that contain a pan that interferes with the growth of roots or movement of water. The features used are soil temperature, major differences in chemical composition (mainly calcium, sodium, magnesium, and potassium), and the like. The names of great groups have three or four syllables and are made by adding a prefix to the name of the suborder. An example is Torripsamment (Torri, meaning dry; psamm, meaning sandy; and ent, from Entisol). The great group is not shown separately in table 8, because it is the last word in the name of the subgroup.

SUBGROUP: Great groups are divided into subgroups, one that represents the central (typic) segment of the group and others, called intergrades, that have properties of one group and also one or more properties of another great group, suborder, or order. Subgroups may also be made in those instances where soil properties intergrade outside of the range of any great group, suborder, or order. The names of subgroups are derived by placing one or more adjectives before the name of the great group. An example is Typic Torripsamment (a typical Torripsamment).

FAMILY: Families are separated within a subgroup primarily on the basis of properties important to growth of plants or behavior of soils when used for engineering. Among the properties considered are texture, mineralogy, reaction, soil temperature, permeability, thickness of horizons, and consistence. A family name consists of a series of adjectives preceding the subgroup name. The adjectives are the class names for texture, mineralogy, and so on, that are used to differentiate families (see table 8). An example is the sandy, siliceous, nonacid, frigid family of Typic Torripsamments.

Texture in the family name applies to the texture of the control section of the soil profile. This is the B horizon in soils with such horizons, providing there is no strongly contrasting horizon below the B horizon or within a depth of 40 inches. If there is a strongly contrasting horizon below the B horizon, then the texture is applied to the soil from the top of the B horizon to a depth of 40 inches. In soils without a B horizon, it is applied to an arbitrary depth between about 10 and 40 inches, or to bedrock, whichever is shallower. The texture of the soils in the Alamosa Area ranges from fine to sandy-skeletal.

Mineralogy refers to the type of material in which the soil formed. Most of the soils are of mixed mineralogy, although some are siliceous (quartz sand) and some are montmorillonitic (dominated by montmorillonite clay) soils.

Reaction identifies a soil as being acid, nonacid, calcareous, or noncalcareous.

All of the soils in the Alamosa Area are frigid as compared to mesic, thermic, or hyperthermic. These terms refer to soil temperature classes. These soils are those with 9° F. or more difference (at a depth of 20 inches) between mean summer (June, July, and August) and mean winter (December, January, and February) temperatures. Soils with less than a 9° difference between mean summer and mean winter temperatures are called isofrigid, isomesic, isothermic, or isohyperthermic. Mesic soils have a mean annual temperature (at a depth of 20 inches) between 47° and 59°. Frigid soils have a lower mean annual temperature (less than 47°) than mesic soils, and thermic soils have a warmer mean annual temperature (59° to 72°). Hyperthermic soils have a mean annual temperature of more than 72°.

Over a large part of the United States, the mean annual soil temperature at a depth of 20 inches is about 2 degrees warmer than the mean annual temperature. In cold or dry climates, there is a wider difference between mean annual air temperature and mean annual soil temperature. Dry, sandy soils have a wider difference in cold climates than do wet, fine-textured soils. The mean annual air temperature at Alamosa is about 41°. The mean annual soil temperature of most soils is 43° to 47°. Table 9 gives temperature readings of four series for the period March through November during one year. The soils were frozen during December, January, and February. The temperature of the frozen soil was 25° to 30°

SERIES: The series has the narrowest range of characteristics of the categories in the classification system. It is explained in the section "How This Survey Was Made."

Morphology of Soils

A detailed description of each of the soil series listed in table 8 is given in the section "Descriptions of the Soils." In the following pages, each of the subgroups represented in the Alamosa Area is discussed in terms of its definitive morphology. A series typical of each subgroup is identified, and significant differences between this series and others in the subgroup are noted.

Typic Psammaquents.--The Gunbarrel series is the only series in this subgroup that occurs in the Alamosa Area. These are coarse-textured soils

TABLE 9.--SOIL TEMPERATURES OF SELECTED SERIES AT A DEPTH OF 20 INCHES

[The Hooper and Space City series did not have any vegetative cover at the places where temperature was taken]

Month	Alamosa series	Gunbarrel series	Hooper series	Space City series
March	32	33	32	32
April	33	37	41	42
May	48	51	52	56
June	52	57	63	64
July	61	67	68	69
August	60	63	69	69
September	56	57	62	62
October	47	47	50	50
November	41	42	43	42
Average annual	43	45	46	47
Average summer	57	62	66	67

supporting grass vegetation under alternating conditions of wetness and dryness. These soils formed in areas that have a fluctuating water table, the height of which depends upon seasonal supplies of ground water. Thus, in periods of abundant groundwater supplies, such as spring, or during the peak periods of irrigation, free water is near the surface. During such periods reduction, hydration, and solution are the dominant processes in the genesis of the soil. During periods of low groundwater supply, the water table may be at a depth below 40 inches and the upper part of the regolith undergoes a dry period in which oxidation, dehydration, and precipitation are dominant. Even though these soils are coarse textured, there commonly is sufficient iron, manganese, and organic matter in them to form at least moderate degrees of contrasting mottling, but matrix colors are of relatively low chroma.

The parent sediments in which these soils formed have been derived, at least in part, from basalt. Enough dark-colored, magnetic sand and silt grains occur throughout the soil to be easily recognized. The presence of relatively finely divided mineral grains, high in content of iron and manganese, has probably contributed to the characteristic morphology, both as a source of supply of soluble inorganic compounds to facilitate mottling and to naturally depress the chroma of the soil matrix.

In general morphology, these soils have horizonation of low contrast. They are characterized by a friable, granular A horizon that is only slightly, if any, darker than the rest of the soil. The C horizon is calcareous, single-grain, loose sand or loamy sand with contrasting mottles of redder hue or brighter chroma than the matrix. The soil generally is noncalcareous in the upper 10 to 15 inches, but may be calcareous at the surface.

Typic Torripsamments.--These soils formed under grassland vegetation in coarse-textured parent sediments. Average annual precipitation is about 6 inches, with peak periods of precipitation occurring in spring and early in summer. Mean annual soil temperature at a depth of 20 inches is about 45° F. where vegetative cover is good and about 47° where there is little or no vegetative cover or where dark-gray minerals are prominent in the sand and silt fractions. Mean summer soil temperature at a depth of 20 inches ranges from 62° to 67° under similar conditions of cover. Most areas of these soils occupy landscapes having dunelike topography, and parent sediments for many of the soils are of eolian origin. In other places these soils formed on alluvial fans where slopes are more uniform, although evidence of some soil blowing generally is found in these areas also.

Morphologically, these soils have only faint horizons. The A horizon is thin; weakly granular; only slight, if any, darker than the rest of the profile; and soft to loose when dry. The C horizon is single grain and loose when dry or moist. Generally, the A horizon and part of the C horizon are noncalcareous, but most soils of the group are calcareous above a depth of 40 inches. Weak horizons of visible accumulation of secondary calcium carbonate occur in some of the soils.

The Cotopaxi series is considered representative of this subgroup in the Alamosa Area. Other members of the subgroup in the survey area include the Costilla soils, which are calcareous above a depth of 40 inches and contain 10 to 25 percent gravel; the Space City soils, which are calcareous above a depth of 40 inches and have continuous though weak horizons of secondary carbonate accumulation; and the Corlett soils, which are forming in sands containing a large proportion of dark-colored ferromagnesian-rich minerals, are calcareous near the

surface, are very strongly alkaline, and have an exchangeable sodium percentage exceeding 15 throughout most of the soil.

Typic Torriorthents.--The soils of this subgroup formed under grass vegetation in parent sediments that are either medium textured to moderately coarse textured or, if coarse textured, contain more than 35 percent coarse fragments. Average annual precipitation is approximately 6 inches, with peak periods of precipitation occurring in spring and early in summer. Mean annual soil temperature measured at a depth of 20 inches is about 45°, and the mean summer soil temperature at the same depth is about 66°.

Typically, these soils have a friable, granular A1 horizon that is only slightly darker than the rest of the soil profile. The C horizon is massive, friable, and generally calcareous. Soils of the Saguache series are an exception because they formed in noncalcareous parent sediments and are noncalcareous to a depth of at least 40 inches. Consistent accumulation of secondary calcium carbonate occurs in the C horizon of some soils of this group.

This subgroup is represented in the Alamosa Area by the Mount Home, Saguache, and Littlebear series. The Mount Home series is representative for the subgroup. The Saguache soils differ in being coarser textured and noncalcareous. The Littlebear soils are coarser textured, contain fewer coarse fragments, are very strongly alkaline, and have a content of exchangeable sodium greater than 15 percent.

Typic Torrifluvents.--The soils of this subgroup formed under grass vegetation in calcareous, very strongly alkaline, stratified alluvium of flood plains and low terraces. They typically have an A, C horizon sequence. A weak horizon of secondary calcium carbonate accmulation or a buried soil horizon commonly occurs inconsistently in these soils, but neither feature is consistent enough to be considered differentiating.

Content of organic carbon varies considerably in these soils, depending largely on the character of the sediments and the history of vegetative growth associated with each successive layer of alluvium that has been deposited. The Laney series is the only representative of this subgroup in the Alamosa Area.

Aeric Halaquepts.--The soils of this subgroup formed under grass and greasewood vegetation in predominantly fine-textured, alluvial parent sediments that are nearly level to gently sloping on flood plains and low terraces. The soils are poorly drained and are associated with a fluctuating water table that is near the soil surface at some seasons of the year. Mean annual soil temperature measured at a depth of 20 inches is about 43°, and mean summer soil temperature at the same depth is about 60°. Although the mean annual precipitation is only 6 inches, the supply of soil moisture is controlled by the water table rather than by yearly precipitation.

Typically, these soils have an A1sa, B2g horizon sequence. The A horizon is light colored, friable, and granular and contains visible accumulation of soluble salt. The B2g horizon is fine textured, is massive or has weak blocky structure, and is intensely mottled. Base colors, however, are redder in hue and brighter in chroma than the colors of the A horizon.

The LaSauses series is the only member of this subgroup in the Alamosa Area.

Aquentic Durorthids.--The Arena series is the only member of this subgroup in the Alamosa Area. These soils formed under greasewood and sparse grass vegetation on flood plains and low terraces on the floor of the San Luis Valley. They formed in moderately fine textured, calcareous, very strongly alkaline, alluvial parent sediments in areas that have a fluctuating water table that is at or near the surface at some seasons of the year. Mean annual soil temperature measured at a depth of 20 inches is about 46.5°, and mean summer soil temperature at the same depth is about 66°. These soils are somewhat warmer than other soils of the survey area because of their sparse vegetative cover.

Morphologically, these soils are characterized by an A1, Cca, Cm horizon sequence. The A1 horizon is thin, is friable, and has weak platy structure parting to granular structure. The upper part of the C horizon is moderately fine textured; is massive or has weak subangular blocky structure; is very strongly alkaline; has base chroma of 2 or less and is mottled. The lower part of the C horizon is a massive indurated pan that will not soften by water or acid but will partially soften in alternate treatments of acid and strong base.

Typic Calciorthids.--These soils formed under grass and greasewood vegetation and are nearly level on parts of the valley floor and gently sloping on alluvial fans. They formed in calcareous, moderately coarse textured, mixed alluvial sediments. Mean annual precipitation is about 6 inches, mean annual soil temperature at a depth of 20 inches is about 45°, and mean summer soil temperature at the same depth is about 62°.

Morphologically, these soils are characterized by an A1, Cca horizon sequence. The A horizon is light colored, friable, and calcareous and has fine granular structure. The Cca horizon is moderately coarse texured and massive and contains large accumulations of visible secondary calcium carbonate.

The McGinty series is the only representative of this subgroup in the Alamosa Area.

Typic Haplargids.--The soils of this subgroup formed under grassland vegetation and are gently sloping on alluvial fans and high terrace levels. Parent sediments vary in character but commonly are alluvial. A contrasting substratum of very gravelly sand is common in this group. Mean annual precipitation is about 6 inches, mean annual soil temperature at a depth of 20 inches is about 45°, and mean summer soil temperature at the same depth is about 66°.

Morphologically, these soils are characterized by an A1, B1, B2t, B3ca, Cca or IICca horizon sequence. The A1 horizon is thin, light colored, and friable and has granular structure. It grades through thin transitional horizons to a B2t horizon that has prismatic to subangular blocky structure and finer texture. Normally, weak evidence of some silicate clay translocation in the form of waxy gelatinous coatings and patches on ped faces can be found. The lower part of the B2t horizon grades into a B3ca horizon in some of the soils. The Cca horizon has visible secondary calcium carbonate accumulating in concretions or seams. Strong concentration of calcium sulfate, mostly in crystalline forms, may also occur in the C horizon of some of the soils in this group. A contrasting IIC horizon of sand and gravel commonly occurs between depths of 20 and 40 inches in some of the soils.

The Acacio, Graypoint, and San Arcacio series belong to this subgroup. The San Arcacio soil may be considered as representative of the subgroup. The Graypoint soils have a gravelly sandy loam B2t horizon, and the Acacio soils have a strong horizon of calcium sulfate accumulation.

Typic Natrargids.--The soils of this subgroup formed under a grass and greasewood vegetation on the flood plains, low terraces, and very gently sloping alluvial fans that form the floor of the San Luis Valley. Parent materials are variable in character but contain sufficient sodium to dominate soil development and have been derived at least in part from basalt and similar rock. The soil profile contains a considerable amount of dark-gray and red magnetic mineral grains in both the sand and silt fractions. Mean annual precipitation is about 6 inches, mean annual soil temperature at a depth of 20 inches is about 45°, and mean summer soil temperature at the same depth is about 66°.

Typically, these soils have an A1, A2, B2t, B3, Cca horizon sequence. In some places the A1 horizon has been removed by soil blowing and only a thin A2 horizon remains above the B2t horizon. In other places there is a contrasting sand and gravel substratum at a depth between 20 and 40 inches. If present, the A1 horizon is thin and light colored and has granular structure. The A2 horizon also is thin, is still lighter in color than the overlying A1 horizon, and has weak platy structure parting to fine granular structure. It rests abruptly on the underlying B2t horizon. The B2t horizon is very strongly alkaline. It varies in texture, depending on the character of the parent sediments, but typically is finer textured than either the overlying A1 and A2 horizons or the underlying C horizon. It typically has columnar structure parting to angular blocky structure; in the coarser textured soils rounded columnar structure is not clearly evident, and the structure is best described as prismatic parting to subangular blocky. Silicate clay translocation in the form of waxy gelatinous coatings on sand grains or on ped faces is clearly evident in the B2t horizon. Below the B2t horizon there is a transitional B3 horizon. The Cca horizon typically is massive and contains visible accumulation of carbonates, with the greatest concentration occurring immediately below the solum.

The Hooper and Mosca series in the Alamosa Area belong to this subgroup. The Hooper series is considered to be typical of the subgroup. The Mosca soils differ from the Hooper soils in having been leached to a somewhat greater depth and in having only a moderately coarse textured B2t horizon.

Aquic Natrargids.--In the Alamosa Area these soils are nearly level to very gently sloping on the flood plains and low terraces that form the floor of the San Luis Valley. They formed under a grass and greasewood vegetation in mixed alluvial parent sediments high in sodium and are underlain by sand and gravel between depths of 20 and 40 inches. Although the mean annual precipitation is only 6 inches, these soils occur in areas that have a high water table, and the available supply of soil moisture is largely controlled by the depth of the water table and its capillary fringe. Because the water table is high, these soils have mottles in some part above the sand and gravel substratum. Mean annual soil temperature at a depth of 20 inches is approximately 43°, and mean summer soil temperature at the same depth is approximately 60°.

Morphologically, these soils are characterized by an A1, A2, B2t, B3ca, Cca, IIC horizon sequence. The A1 horizon is thin, light colored, and calcareous and has fine granular structure. The A2 horizon is lighter colored than either the overlying A1 or the underlying B2t horizon; it is thin and friable and has weak, fine, platy structure parting to fine granular structure. In cultivated fields the A1 and A2 horizons have been mixed. The B2t horizon is moderately fine textured, calcareous, and very strongly alkaline and has prismatic structure parting to subangular blocky structure. Evidence of clay movement in the form of waxy gelatinous coatings on the surfaces of the peds and along root channels is found in the B2t horizon. Below the B2t horizon there is a transitional B3ca horizon of secondary calcium carbonate. The Cca horizon generally is relatively thin, depending on the depth to the underlying coarse-textured substratum. It commonly is moderately fine textured, very strongly alkaline, and calcareous and contains a visible accumulation of calcium carbonate and reddish brown mottles. The IIC horizon may occur at any depth between 20 and 40 inches and consists mainly of loose sand and gravel.

The San Luis series is the only representative of this subgroup in the Alamosa Area.

Typic Haplaquolls.--The soils of this subgroup formed under a grass and sedge vegetation in depressions or nearly level areas of flood plains and low terraces. They formed in mixed alluvial sediments that range in texture from sand to loam and were derived from a variety of rocks, including basalt and other ferromagnesian-rich materials. The mean annual precipitation is only about 6 inches, but the available water supply in these soils is controlled by a permanent high water table that occurs

at or near the surface most of the year. Because of the available water within the reach of roots, the vegetation in these areas is much more dense than in the rest of the survey area, and in consequence, the soils have a much darker colored A horizon. Mean annual soil temperature at a depth of 20 inches is about 45°, and mean summer soil temperature at the same depth is about 60°.

Morphologically, these soils have an A1, B2g horizon sequence. In some places a IICg horizon consisting of very gravelly sand may occur at depths between 20 and 40 inches. In other places the C horizon is coarse textured and, although mottled, is not considered to be a B2g horizon. The A1 horizon in these soils is comparatively thick, ranging from about 10 to 24 inches in thickness; is dark colored; and has granular or weak subangular blocky structure. Typically, the dark-colored A1 horizon has common to many, distinct to prominent mottles in the lower part. The B2g horizon has low chroma, generally has hues of 10YR or yellower, is strongly mottled, at least in the upper part, and may be uniformly gleyed in the lower part.

The LaJara, Medano, and Vastine series of the Alamosa Area belong to this subgroup. The LaJara series is considered to be typical of the subgroup. The Medano soils differ from the LaJara soils in being coarse textured to a depth of more than 40 inches. The Vastine soils differ from the LaJara soils in having a finer textured upper control section that overlies a contrasting sand and gravel substratum and in being noncalcareous throughout.

Typic Argiaquolls.--The soils of this subgroup formed under a thick growth of water-tolerant grasses, sedges, and rushes and are nearly level to depressional in areas of flood plains and low terraces on the floor of the San Luis Valley. The parent sediments were mixed, weakly calcareous alluvium derived from a variety of sources. Although the mean annual precipitation is only about 6 inches, the effective moisture supply for these soils is controlled by a fluctuating and relatively high-standing water table. Depth to the water table varies from season to season, but the water table is at or near the surface or within the rooting zone for a good part of each growing season. In consequence, the plant cover for these soils has been much more dense than for most of the soils of the Alamosa Area. This is reflected in the darker colored and thicker A1 horizon. Mean annual soil temperature at a depth of 20 inches is approximately 43°, and mean summer soil temperature at the same depth is about 60°.

Morphologically, these soils are characterized by an A1, B2t, B3cag, Cg horizon sequence. The A horizon is dark colored, friable, and noncalcareous and has granular structure. The B2t horizon also is relatively dark colored and contains common to many, distinct, prominent mottles. The texture of the B2t horizon is finer than that of the overlying A1 horizon. The B2t horizon typically has subangular blocky structure. Clay translocation is visible in the form of waxy coatings on ped faces and in root channels in this horizon. Below the B2t horizon is a transitional B3cag horizon that has some accumulation of secondary calcium carbonate, principally in small concretions or in thin seams and streaks. Below this horizon there is a lighter colored C horizon that is noncalcareous and is strongly mottled.

The Alamosa series is the only representative of this subgroup in the Alamosa Area.

Typic Calciaquolls.--The soils of this subgroup formed under a thick growth of water- and salt-tolerant grasses and sedges and are nearly level in areas of flood plains and low terraces on the floor of the San Luis Valley. The parent sediments are mixed calcareous alluvium derived from basic igneous rocks. Although the mean annual precipitation is only about 6 inches, the effective soil moisture is controlled by the fluctuating and relatively high water table that is characteristic of these soils. Depth to the water table varies from season to season, but the water table is within the rooting zone for a good part of each growing season. As a result, the plant cover is more dense than for most other soils in the survey area and the A1 horizon is thicker and darker. Mean annual soil temperature at a depth of 20 inches is approximately 43°, and mean summer soil temperature is approximately 60°.

Morphologically, these soils are characterized by an A1, C1cs, C2g, C3 horizon sequence. The A horizon is dark colored, friable, and calcareous and has granular structure. Below the A horizon is the Ccs horizon, which is mottled and contains much accumulated calcium sulphate. This overlies the C2g horizon, which is massive and strongly mottled from poor drainage.

The Nortonville series is the only representative of this subgroup in the Alamosa Area.

Lithic Haploborolls.--In the Alamosa Area these soils formed on very steeply sloping parts of the Sangre De Cristo Mountain Range. They formed under vegetation consisting mainly of pinyon and juniper, along with interspersed areas of grasses. The parent materials have weathered from underlying hard igneous and metamorphic bedrock. Depth to bedrock ranges from 10 to 20 inches. Mean annual precipitation is estimated to be about 15 inches, and peak periods of precipitation are in spring and early in summer. Mean annual soil temperature is estimated to be about 44°, and mean summer soil temperature, about 60°.

Morphologically, these soils are characterized by an A1, C, R horizon sequence. The A1 horizon is friable and slightly acid and has fine granular structure. The C horizon typically is very stony loam that is 60 to 80 percent coarse fragments, most of which are larger than 10 inches in diameter. The horizon is friable and slightly acid. It abruptly overlies hard igneous or metamorphic bedrock.

The Comodore series is the only representative of this subgroup in the Alamosa Area.

Aquic Fluvaquentic Haploborolls.--In the Alamosa Area these soils formed under a grass vegetation on

the flood plains and low terraces that formed the floor of the San Luis Valley. The parent sediments are highly stratified but are predominantly medium-textured alluvium derived from a variety of rock sources. Although the mean annual precipitation is only about 6 inches, these soils have a fluctuating water table that contributes significantly to the available moisture supply for growing plants. This somewhat more favorable supply of soil moisture has resulted in more luxuriant growth of plants. This, in turn, is reflected in these soils having a somewhat darker and thicker A horizon than is typical for the remainder of the Area. Although these soils are associated with a fluctuating water table, the water table generally is not high enough, and is not persistent enough, to have altered the morphology of the soils to that of Haplaquolls, which have been previously described. The mean annual soil temperature at a depth of 20 inches is approximately 45°, and the mean summer soil temperature measured at the same depth is approximately 62°.

Morphologically, these soils have an A1, C1g horizon sequence. The A1 horizon is moderately dark colored, friable, and noncalcareous and has weak, subangular blocky structure parting to fine granular structure. The C horizon consists of highly stratified loam, very fine sandy loam, clay loam, and sandy loam; its weighted average texture is approximately that of loam.

The Home Lake series is the only representative of this subgroup in the Alamosa Area.

Aridic Argiborolls.--The soils of this subgroup in the Alamosa Area formed under a grass and rabbitbrush vegetation in nearly level areas or under pinyon tree vegetation on steep alluvial fans and high terraces. They either are at the somewhat higher elevations along margins of the survey area where mean annual rainfall is higher than in the valley proper, or they occupy nearly level areas where runoff has contributed to the amount of effective soil moisture available for plant growth. The parent materials are variable but, in general, are medium-textured to moderately fine textured alluvium derived from a variety of rock sources. In some places the parent sediments consist dominantly of materials derived from basalt and similar rock and contain a large amount of dark-gray and reddish-colored magnetic mineral grains in the sand and silt fraction. The Uracca soils formed in material that contains large amounts of granite cobblestones and boulders. The mean annual precipitation ranges from about 6 to 12 inches; however, the soils in the lower rainfall areas are nearly level and have probably received additional amounts of moisture that contributed to their formation. Mean annual soil temperature at a depth of 20 inches is approximately 44°, and mean summer soil temperature at the same depth is approximately 60°.

Morphologically, these soils have an A1, B2t, B3ca, Cca horizon sequence. The A1 horizon is dark colored, noncalcareous, and friable and has granular structure. The B2t horizon has prismatic to subangular blocky structure, is typically noncalcareous, and is finer in texture than the overlying A1 and B1 horizons. Generally, there is evidence of clay translocation in waxy and gelatinous coatings on ped faces or in root channels in the B2t horizon. Below the B2t horizon is a transitional B3ca horizon that contains some visible secondary calcium carbonate, principally in soft concretions and nodules. The Cca horizon typically is calcareous and contains a visible accumulation of secondary calcium carbonate, the strongest part of such accumulation occurring immediately below the solum.

The Uracca and Villa Grove series are representatives of this subgroup in the Alamosa Area. The Villa Grove series is considered to be a representative example of the subgroup. The Uracca soils differ from the Villa Grove soils primarily in having 60 to 90 percent coarse fragments throughout the solum and C horizon. Most of the coarse fragments are gravel and cobblestones.

Aridic Calciborolls.--In the Alamosa Area these soils formed on nearly level to very gently sloping low terraces of alluvial fans that make up the floor of the San Luis Valley. They formed under a grass vegetation. Although the mean annual precipitation is only about 6 inches, the effective moisture available to plant growth on these soils is somewhat higher because their position in most landscapes is conducive to the accumulation of some runoff. In addition, they receive some beneficial amounts of water from a water table that rises high enough in some seasons to place its capillary fringe within the reach of plant roots. The mean annual soil temperature at a depth of 20 inches is estimated to be about 45°, and the mean summer soil temperature at the same depth is estimated to be about 62°.

Morphologically, these soils have an A1, Cca horizon sequence. The A1 horizon is moderately dark colored, calcareous, and friable and has weak blocky structure parting to moderate, fine, granular structure. The Cca horizon is medium textured and very calcareous and contains a large amount of accumulated secondary calcium carbonate and calcium sulfate in its upper part. The amount of accumulated calcium carbonate and calcium sulfate decreases below a depth of about 30 inches.

The Zinzer series is the only representative of this subgroup in the Alamosa Area.

Aridic Natriborolls.--In the Alamosa Area these soils formed under a grass and greasewood vegetation and are nearly level to very gently sloping on the flood plains and low terraces that make up the floor of the San Luis Valley. They formed in calcareous, medium-textured to fine-textured alluvial sediments that are high in sodium and were derived from a variety of sources. Although the mean annual precipitation is only about 6 inches, these soils receive additional moisture from a fluctuating water table. They also receive some additional moisture as runoff from surrounding areas. The mean annual soil temperature at a depth of 20 inches is approximately 45°, and the mean summer soil temperature at the same depth is approximately 62°.

TABLE 10.--PARTICLE-SIZE DISTRIBUTION AND CHEMICAL

[Analytical data for all soils except the Hapney obtained from Soils Laboratory, Soil Conservation Service,
Conservation Service, Lincoln, Nebraska. Dashes indicate

Soil name, sample number, and location	Horizon	Depth	Particle-size distribution					
			Very coarse sand	Coarse sand	Medium sand	Fine sand	Very fine sand	Total sand
		Inches	Percent	Percent	Percent	Percent	Percent	Percent
Acacio loam:								
S63 Colo-2-111; 0.25	A1	0-4	6.2	12.6	13.3	19.5	14.6	66.2
mile W. and 36 feet	B21t	4-7	1.7	8.6	12.8	19.1	13.1	1/ 55.3
S. of NE. corner of	B22tsa	7-10	3.1	10.2	13.4	18.4	12.4	1/ 57.5
sec. 11, T. 36 N.,	C1	10-16	3.2	8.2	10.6	16.0	12.0	50.0
R. 9 E.	C2cs	16-44	---	----	----	----	----	----
	C3	44-60	.9	2.4	3.1	3.9	9.1	19.4
Alamosa loam:								
S63 Colo-2-130; 1,050	Ap	0-9	1.9	4.7	3.7	8.9	12.6	31.8
feet N. and 1,150 feet	B21t	9-17	1.1	3.4	2.2	4.6	10.7	22.0
E. of S. quarter corner	B22t	17-27	1.5	4.1	2.2	2.5	9.9	20.2
of sec. 21, T. 38 N.,								
R. 10 E.								
Arena loam:								
S63 Colo-2-118; 1,250	A11	0-2	2.0	7.4	7.8	12.3	11.9	41.4
feet E. and 950 feet	A12	2-5	1.8	5.6	5.8	9.5	11.9	34.6
N. of SW. corner of	AC	5-13	1.4	5.4	5.7	10.1	13.7	36.3
sec. 30, T. 38 N., R.	C1	13-23	1.0	4.5	6.3	11.7	18.6	42.1
9 E.	C2casa	23-33	4.2	9.2	10.5	15.9	18.0	57.8
	C3sam	33-48	---	----	----	----	----	----
Corlett sand:								
S63 Colo-2-119; 300 feet	A1	0-8	1.3	14.0	16.4	38.4	23.3	93.4
N. and 300 feet W. of	C1	8-24	1.0	12.9	18.2	41.8	16.5	90.4
S. quarter corner of	C2	24-36	.5	25.5	26.7	32.2	10.6	95.5
sec. 36, T. 40 N., R.	C3	36-60	.1	8.4	19.4	49.9	14.4	92.2
11 E.								
Costilla loamy sand:								
S63 Colo-2-116; 1,050	A1	0-4	5.4	13.7	14.4	33.3	21.7	88.5
feet W. and 1,850 feet	AC	4-13	4.7	12.3	14.5	34.0	21.1	86.6
S. of NE. corner of	C1	13-19	3.4	11.2	13.4	32.3	21.3	81.6
sec. 11, T. 36 N., R.	C2ca	19-41	4.9	13.7	15.7	30.1	16.8	81.2
11 E.	C3	41-60	7.7	16.2	17.1	29.3	15.0	85.3
Graypoint gravelly sandy loam:								
S63 Colo-2-123; 2,500	A21	0-1	9.2	27.1	14.3	14.5	10.1	75.2
feet S. and 900 feet	A22	1-4	9.7	24.9	13.9	14.6	10.0	73.1
W. of NE. corner of	B2t	4-10	6.6	15.3	12.6	20.5	14.0	69.0
sec. 25, T. 39 N., R.	B3	10-12	12.5	21.0	11.9	21.3	11.5	78.2
9 E.								

See footnotes at end of table.

CHARACTERISTICS OF SELECTED SOILS IN THE ALAMOSA AREA, COLORADO

Colorado State University, Fort Collins, Colorado. Data for Hapney soil obtained from Soils Laboratory, Soil values not determined. The symbol > means greater than]

Particle-size distribution--Cont.		Reaction		Electrical conductivity ECx10³	Organic carbon	Calcium carbonate equivalent	Moisture at saturation	Cation exchange capacity	Exchangeable cations		Exchangeable sodium
Silt	Clay	Paste	1:5						Exchangeable sodium	Exchangeable potassium	
Percent	Percent	pH	pH	Millimhos per cm.	Percent	Percent	Percent	Meq./100 g.	Meq./100 g.	Meq./100 g.	Percent
22.7	11.1	7.6	8.6	2.0	1.1	0.8	25.4	10.0	---	---	---
18.1	26.6	8.0	8.8	4.5	.9	3.3	39.1	16.0	---	---	---
18.8	23.7	7.9	8.4	10.0	1.0	8.0	39.0	13.7	---	---	---
22.8	27.2	8.0	8.4	12.0	1.1	16.3	43.1	13.7	---	---	---
----	----	7.9	8.0	8.5	.2	1.9	52.3	10.3	---	---	---
44.7	35.9	7.8	8.0	6.0	.2	10.6	55.2	23.0	---	---	---
36.2	32.0	7.7	8.7	.9	1.4	1.3	45.3	27.0	1.3	1.5	4.9
41.8	36.2	7.9	8.5	.5	1.0	.8	50.5	34.0	2.3	.5	6.8
46.8	33.0	7.9	8.5	.5	1.3	1.1	51.5	34.0	2.8	.5	8.1
29.7	28.9	9.2	10.1	>15.0	.8	11.0	24.5	18.5	15.9	7.8	85.7
26.2	39.2	10.0	10.3	9.0	.6	20.1	40.0	19.0	15.4	6.4	80.8
32.7	31.0	9.9	10.2	7.5	.4	19.9	35.2	16.0	12.4	4.4	77.6
37.7	20.2	9.7	10.0	3.0	.2	3.9	38.9	14.7	11.1	4.9	75.4
24.3	17.9	8.8	9.8	1.5	.2	6.4	42.4	15.3	11.4	4.7	74.6
----	17.0	8.6	9.7	---	---	5.9	----	----	----	---	----
4.3	2.3	9.1	9.8	.6	.2	3.1	23.6	4.2	.9	1.4	21.2
5.1	4.5	9.2	9.8	1.0	.3	4.8	23.5	5.0	1.4	1.6	27.8
1.7	2.8	9.8	10.2	1.8	.1	2.7	25.2	4.4	2.8	2.0	62.5
1.9	5.9	9.5	10.0	1.6	.1	4.0	27.5	6.0	4.3	2.4	72.3
6.4	5.1	7.4	7.8	.4	.5	.2	23.8	5.0	.2	.4	3.8
6.1	7.3	7.9	8.7	.3	.6	.4	24.4	6.0	.2	.4	3.2
9.5	8.9	8.0	8.9	.4	.5	3.2	26.9	7.4	.2	.6	2.4
8.9	9.9	8.1	9.1	.4	.4	6.2	26.1	7.0	.2	.4	2.4
7.3	7.4	8.2	9.0	1.1	.2	4.3	23.7	5.8	.5	.2	8.3
19.8	5.0	6.7	7.3	.7	.4	.3	16.7	7.0	.7	1.0	5.1
19.2	7.7	7.0	7.8	.3	.3	.3	15.6	8.0	.3	1.2	4.6
16.5	2/14.8	7.5	8.1	.4	.9	.4	26.4	14.0	.4	2.0	2.4
11.4	10.4	8.0	9.1	.5	.4	2.5	24.3	13.0	.5	1.6	5.5

Soil name, sample number, and location	Horizon	Depth	Particle-size distribution					
			Very coarse sand	Coarse sand	Medium sand	Fine sand	Very fine sand	Total sand
		Inches	Percent	Percent	Percent	Percent	Percent	Percent
Gunbarrel loamy sand:								
MH 48-51; 8160-8163; 500 feet S. and 320 feet W. of NE. corner of sec. 16, T. 39 N., R. 10 E.	Ap	0-6	---	---	---	---	---	83.0
	C1	6-27	---	---	---	---	---	84.0
	C2	27-45	---	---	---	---	---	87.0
	IIC3	45-60	---	---	---	---	---	92.0
Hapney loam:								
S64 Colo-2-1; 695 feet W. and 75 feet S. of NE. corner of sec. 27, T. 38 N., R. 11 E.	B21t	5-13	---	---	---	---	---	----
	B22t	13-23	---	---	---	---	---	----
Hooper loamy sand:								
S63 Colo-2-120; 150 feet E. and 20 feet S. of S. quarter corner of sec. 31, T. 38 N., R. 9 E.	A22	4-7	5.2	11.7	10.6	18.3	12.2	58.0
	B2t	7-12	2.1	6.5	7.3	14.0	11.4	41.3
	B3	12-16	4.4	8.2	8.7	17.5	15.7	54.5
	C1ca	16-32	2.4	9.7	13.3	23.9	20.6	69.9
	IIC2	32-60	11.2	17.9	19.5	26.8	16.3	91.7
LaJara loam:								
S63 Colo-2-135; 1,200 feet E. and 300 feet N. of SW. corner of sec. 16, T. 36 N., R. 10 E.	A1	0-10	.4	1.2	2.3	10.1	16.3	30.3
	B21g	10-25	.1	.4	1.0	8.9	32.7	43.1
	B22g	25-50	0	.4	1.3	21.3	30.0	53.0
	IIC	50-60	1.5	14.3	38.1	33.8	4.3	92.0
Laney loam:								
S63 Colo-2-114; 1,700 feet S. and 500 feet W. of NE. corner of sec. 8, T. 37 N., R. 12 E.	A1	0-4	.2	1.3	4.7	22.4	27.6	3/56.2
	AC	4-11	0	1.1	4.4	21.8	23.1	50.4
	C1	11-17	.1	1.3	5.0	22.9	21.3	50.6
LaSauses sandy clay loam:								
S63 Colo-2-133; 2,400 feet N. of SE. corner of sec. 9, T. 36 N., R. 10 E.	A1sa1	0-5	.6	3.1	4.1	17.2	29.6	54.6
	A1sa2	5-10	.4	2.2	3.1	14.1	21.3	41.1
	B21g	10-17	.1	.9	1.4	3.5	5.7	11.6
	B22g	17-60	.1	.3	.4	1.2	1.5	3.5
Littlebear sandy loam:								
S63 Colo-2-129; 1 mile S. and 200 feet W. of E. quarter corner of sec. 1, T. 38 N., R. 12 E.	A11	0-4	4.0	8.2	7.3	19.5	32.3	71.3
	A12	4-15	5.7	9.8	9.4	22.9	27.1	74.9
	AC	15-23	6.7	11.2	10.4	22.0	26.6	76.9
McGinty sandy loam, saline:								
S63 Colo-2-132; 500 feet S. and 2,140 feet W. of NE. corner of sec. 32, T. 37 N., R. 10 E.	Ap	0-6	7.3	15.3	13.1	18.2	15.6	69.5
	AC	6-12	8.0	18.0	13.8	17.1	13.4	70.3
	C1	12-17	4.3	11.1	11.8	17.4	17.1	61.7
	C2ca	17-32	4.5	11.3	12.3	17.6	17.6	63.3

See footnotes at end of table.

Particle-size distribution--Cont.		Reaction		Electrical conductivity ECx103	Organic carbon	Calcium carbonate equivalent	Moisture at saturation	Cation exchange capacity	Exchangeable cations		Exchangeable sodium
Silt	Clay	Paste	1:5						Exchangeable sodium	Exchangeable potassium	
Percent	Percent	pH	pH	Millimhos per cm.	Percent	Percent	Percent	Meq./100 g.	Meq./100 g.	Meq./100 g.	Percent
11.0	6.0	9.1	9.7	1.5	0.4	0.7	19.4	7.2	---	---	---
9.0	7.0	9.3	9.9	1.8	---	1.2	19.1	8.3	---	---	---
7.0	6.0	8.7	9.5	1.5	---	1.2	20.0	6.5	---	---	---
4.0	4.0	8.5	9.1	1.3	---	2.3	20.7	5.0	---	---	---
---	---	8.1	3/ 9.0	.78	---	---	59.7	28.6	3.5	1.8	11.0
---	---	8.0	3/ 9.2	.81	---	---	65.4	33.3	5.7	1.3	16.0
23.3	18.7	8.7	9.8	2.4	.8	13.2	16.2	9.0	5.3	2.3	59.0
19.5	39.2	9.6	10.3	5.0	.4	16.4	46.3	---	17.1	3.9	97.8
24.9	20.6	10.1	10.4	7.0	.1	10.6	32.2	14.0	10.9	2.6	77.5
17.5	12.6	9.9	10.4	2.8	.1	5.8	30.6	12.7	10.0	2.0	78.6
5.2	3.1	9.4	10.0	1.1	.1	1.2	25.5	7.6	6.3	1.0	82.8
33.3	35.4	6.7	7.0	3.2	6.2	.9	62.3	26.0	.5	.9	1.8
41.4	15.5	7.3	7.9	1.9	.4	.6	40.8	16.7	1.9	.5	2.9
32.3	14.7	7.2	7.7	1.4	.4	.4	40.0	16.7	1.4	.2	.9
4.0	4.0	7.3	7.6	1.3	.1	.4	36.6	8.8	1.3	.3	3.0
33.4	2/10.4	8.4	9.4	1.5	2.0	14.7	34.1	11.7	2.6	4.2	22.1
35.1	14.5	9.0	9.9	5.0	1.5	18.0	36.4	15.3	9.7	6.4	63.7
26.0	23.4	9.5	10.2	11.0	.9	23.2	34.6	13.3	9.3	5.5	70.1
27.5	17.9	8.1	8.6	>15.0	1.3	2.4	35.3	11.7	5.4	2.1	46.2
32.4	26.5	8.0	8.5	>15.0	1.1	2.3	47.5	18.0	5.2	2.9	29.0
50.9	37.5	7.1	7.5	>15.0	1.1	.5	69.7	27.0	2.0	2.0	7.6
33.7	62.8	4.9	5.9	4/15.0	1.1	.1	99.4	25.0	2.6	1.2	10.4
22.5	6.2	8.4	9.8	2.8	1.7	1.0	31.3	8.0	1.4	3.6	17.1
15.3	9.8	8.2	9.5	4.5	.9	.6	25.3	8.4	2.4	1.9	28.6
15.9	7.2	7.0	7.9	4.5	.7	.2	23.8	7.2	1.2	.4	16.8
19.9	10.6	7.8	8.2	8.0	1.1	.7	25.5	9.0	---	---	----
17.7	12.0	8.0	8.3	12.0	1.6	1.1	26.8	12.0	---	---	----
21.2	17.1	7.6	8.0	8.5	.5	1.1	28.5	13.5	---	---	----
22.2	14.5	7.7	8.2	6.5	.4	---	28.5	12.0	---	---	----

Soil name, sample number, and location	Horizon	Depth	Particle-size distribution					
			Very coarse sand	Coarse sand	Medium sand	Fine sand	Very fine sand	Total sand
		Inches	Percent	Percent	Percent	Percent	Percent	Percent
Nortonville loam:								
S63 Colo-2-136; 1,300 feet S. and 600 feet E. of center of sec. 7, T. 36 N., R. 11 E.	A1cs	0-5	0.3	1.1	2.3	13.3	23.0	40.0
	ACcs	5-9	.1	.7	1.6	11.4	21.2	35.0
	C1cs	9-14	.1	.6	1.4	10.5	19.6	32.2
	C2g	14-29	.2	.6	1.7	15.1	25.1	42.7
	C3	29-60	.1	.6	1.2	16.6	30.0	48.5
San Arcacio sandy loam:								
S63 Colo-2-110; 950 feet N. and 100 feet E. of SW. corner of sec. 25, T. 37 N., R. 9 E.	Ap	0-9	6.8	15.7	14.1	15.1	11.7	63.4
	B2t	9-14	6.2	13.4	12.7	15.4	11.5	1/59.2
	C1ca	14-17	5.6	12.9	15.7	23.8	10.2	68.2
	C2	17-23	13.5	21.8	21.2	24.6	6.7	87.8
San Luis sandy loam:								
S64 Colo-2-137; 1,000 feet W. and 50 feet N. of E. quarter corner of sec. 13, T. 39 N., R. 10 E.	Ap	0-7	10.3	20.7	16.1	18.4	12.6	78.1
	B21t	7-9	2.6	9.5	13.2	19.6	11.8	56.7
	B22t	9-12	2.0	10.0	11.7	16.6	9.8	50.1
	B3ca	12-16	2.4	9.7	10.8	13.6	6.7	43.2
	C1ca	16-34	2.6	8.1	10.2	10.4	10.1	41.4
	IIC2	34-60	1.7	12.3	18.7	32.5	11.2	86.4
Space City loamy fine sand:								
S62 Colo-2-132; 20 feet E. of NW. corner of sec. 30, T. 38 N., R. 13 E.	A1	0-9	4.6	12.6	15.8	38.5	20.0	91.5
	C1	9-30	3.7	9.7	13.6	42.3	21.4	90.7
	C2ca	30-48	4.2	9.8	11.1	38.2	26.1	89.4
Vastine loam:								
S63 Colo-2-117; 2,550 feet E. and 300 feet N. of SW. corner of sec. 30, T. 38 N., R. 9 E.	A1	0-10	3.0	6.6	5.9	12.2	20.2	47.9
	B2g	10-30	2.6	7.3	7.2	16.5	18.6	52.2
	IICg	30-60	20.5	27.4	18.8	13.9	4.4	85.0

1/ Analysis not considered typical for horizon. Horizon typically contains less sand than is indicated by analysis.

2/ Analysis not considered typical for horizon. Horizon typically contains more clay than is indicated by analysis.

Particle-size distribution--Cont.		Reaction		Electrical conductivity ECx103	Organic carbon	Calcium carbonate equivalent	Moisture at saturation	Cation exchange capacity	Exchangeable cations		Exchangeable sodium
Silt	Clay	Paste	1:5						Exchangeable sodium	Exchangeable potassium	
Percent	Percent	pH	pH	Millimhos per cm.	Percent	Percent	Percent	Meq./ 100 g.	Meq./ 100 g.	Meq./ 100 g.	Percent
36.4	23.6	7.9	8.5	>15.0	4.4	5.7	57.6	23.0	5.1	4.4	22.3
37.3	27.7	8.0	8.5	>15.0	2.3	4.4	54.4	16.0	5.3	2.3	33.0
40.7	27.1	8.0	8.4	15.0	2.0	5.1	61.1	14.0	5.0	1.6	35.9
35.8	21.5	7.7	8.2	3.6	1.7	4.1	48.3	19.0	1.2	.9	6.2
33.4	18.1	7.5	8.0	2.8	.5	.6	43.6	18.7	.6	.3	3.3
23.0	13.6	7.5	8.1	3.6	1.1	.8	25.1	11.2	.8	1.2	6.9
23.0	2/ 17.8	7.7	8.4	1.8	.9	1.1	33.6	13.0	.8	1.3	5.9
15.7	16.1	7.8	8.5	1.7	.6	4.3	29.4	12.0	.6	.8	5.2
6.0	6.2	7.9	8.6	2.0	.2	1.6	22.0	6.6	.4	.4	6.4
16.3	5.6	7.6	8.1	1.4	1.0	.5	24.4	7.6	.3	1.7	3.8
20.0	23.3	8.0	9.1	2.0	.6	1.1	40.1	19.0	5.7	2.5	29.7
23.2	26.7	8.2	9.4	2.8	.6	2.8	52.8	23.0	8.5	2.9	36.7
30.7	26.1	8.3	9.4	5.5	.6	3.8	55.8	24.0	8.3	2.4	34.7
32.2	26.4	8.3	9.4	4.5	.5	7.3	54.1	22.0	9.2	1.9	42.0
6.5	7.1	8.5	9.5	1.6	.1	.8	25.1	10.0	3.6	1.0	35.7
4.5	4.0	7.8	8.1	.3	.3	.4	20.1	6.0	.2	.8	3.0
4.4	4.9	7.8	8.3	.4	.3	.3	23.5	6.7	.2	.6	2.7
5.7	4.9	8.1	8.4	.6	.1	1.2	22.2	7.0	.2	.8	2.6
29.7	22.4	7.7	8.4	1.7	8.9	.3	47.9	21.7	1.3	.7	6.1
25.4	22.4	7.2	8.0	.7	.6	.2	42.0	16.7	.9	.3	5.3
7.1	7.9	7.5	8.4	1.3	.3	.3	----	----	----	----	----

3/ pH at 1:10 dilution.

4/ Considerable amount of gypsum was present in horizon.

Morphologically, these soils are characterized by an A2, B1, B2t, C horizon sequence. The A2 horizon is very thin, is light colored, and has fine platy structure parting to granular structure. It rests abruptly on an underlying B1 horizon that is light clay loam in texture and has granular structure. The B2t horizon is moderately dark colored, is light clay or heavy clay loam in texture, and has prismatic structure parting to angular and subangular blocky structure. Most of the horizon is calcareous. It is very strongly alkaline and has pH values ranging from about 8.6 to 10.0. Apparent clay translocation in the form of waxy and gelatinous coatings on ped faces and along root channels can be found in this horizon. The C horizon typically is noncalcareous, massive, and moderately fine textured. This horizon commonly is only moderately alkaline to strongly alkaline. A contrasting IIC horizon occurs between depths of 40 and 60 inches in the Hapney soils.

The Hapney series is the only series representing this subgroup in the Alamosa Area.

Physical and Chemical Analyses

The data obtained by physical and chemical analyses of selected soils in the Alamosa Aréa are given in table 10. Profiles of all of the soils listed in the table, except the Alamosa, Graypoint, Gunbarrel, and McGinty soils, are described in the section "Descriptions of the Soils." The data in this table are useful to soil scientists in classifying soils and in forming concepts of soil genesis. They also are helpful in estimating available water holding capacity, soil blowing, fertility, tilth, and other aspects of soil management. The data on reaction, electrical conductivity, and exchangeable sodium are helpful in evaluating the feasibility of reclaiming or improving saline or alkali soils. The data are helpful in classifying soils for engineering uses, including the effects of the soils on concrete, their suitability for reservoir sites, and their stability in ditchbanks.

Field and Laboratory Methods

All samples used to obtain the data in table 10 were collected from carefully selected pits. Most of the samples are considered representative of the soil material that is smaller than gravel. Only the ovendry material smaller than gravel size was analyzed. The results in the table were calculated from the total weight of particles smaller than 2 millimeters. Gravel was screened and discarded from the Costilla, Graypoint, Gunbarrel, and San Arcacio soils before the samples were sent to the laboratory.

Unless otherwise noted, all laboratory analyses are made on material that passes the 2-millimeter sieve and are reported on an ovendry basis. Values for exchangeable sodium and potassium are for amounts of sodium and potassium that have been extracted by the ammonium acetate method, minus the amounts in the saturation extract.

Standard methods of the Soil Survey Laboratory were used to obtain most of the data in table 10. Determinations of clay content were made by the pipette method (6, 7, 9). The reaction of the saturated paste and that of a 1:5 water suspension were measured with a glass electrode. Organic carbon was determined by wet combustion, using a modification of the Walkley-Black method (10). The calcium carbonate equivalent was determined by measuring the volume of carbon dioxide released from soil samples treated with concentrate hydrochloric acid. The cation exchange capacity was determined by direct distillation of absorbed ammonia (10). Exchangeable sodium and potassium were determined on original extracts with a flame spectrophotometer. The methods of the U.S. Salinity Laboratory were used to obtain the saturation extract (13). Soluble sodium and potassium were determined on the saturation extract with a flame spectrophotometer.

Interpretation of Laboratory Data

The analyses of the soils listed in table 10 show a wide range in most of the properties analyzed between one soil and another. Because of these great differences among the soils, interpretation can best be made on the individual soils or on similar soils. A few generalizations may be made on some of the chemical and physical properties, however.

Sand makes up more than half the mineral fraction of the control section of all the soils analyzed, except the Alamosa, Arena, Hooper, LaJara, LaSauses, Nortonville, and San Luis soils. The very coarse sand fraction makes up only a small part of the total sand in most of the soils. It makes up from 5 to 10 percent of the sand fraction of the San Arcacio, Costilla, Littlebear, McGinty, and Graypoint soils.

Coarse sand and medium sand occur in about the same proportion. These two sand sizes make up a significant part of the sand fraction of all the soils except the LaJara, Laney, LaSauses, and Nortonville soils.

Fine sand dominates the sand fraction in many of the soils. These include the Corlett, Costilla, Acacio, Space City, San Luis, and Zinzer soils. Very fine sand dominates the sand fraction of the Alamosa, Arena, LaJara, Littlebear, LaSauses, Nortonville, and Vastine soils. Fine sand and very fine sand make up a significant part of the sand fraction of all the soils.

The silt fraction makes up less than 10 percent of the mineral fraction in the Corlett, Costilla, Gunbarrel, and Space City soils. Seven of the soils analyzed--the Alamosa, Arena, LaJara, LaSauses, Nortonville, San Luis, and Vastine soils--are between 25 and about 40 percent silt. The LaSauses soil is about 50 percent silt in one horizon. The rest of the soils analyzed are between 10 and 25 percent silt

Clay makes up a significant part of the mineral fraction of most of the soils. Those that are less than 10 percent clay are the Corlett, Costilla,

Gunbarrel, Littlebear, and Space City soils. The Corlett and Space City soils are less than 5 percent clay. Some of the soils have a clay increase in the B horizon that indicates clay movement from the A horizon to the B horizon. These soils are the Alamosa, Acacio, San Arcacio, Graypoint, Hooper, and San Luis soils. Some soils contain more clay in certain horizons than in others as a result of stratification rather than clay movement. Many of the soils have a clay content in the range of 20 to 35 percent in the control section of the profile.

The analyses show that many of the soils are very strongly alkaline, and the pH values are as high as 10.3 in some of the soils. Soils that are very strongly alkaline at a 1:5 soil-water dilution are the Arena, Corlett, Gunbarrel, Hapney, Hooper, Laney, Littlebear, and San Luis soils. Alamosa, Costilla, and Acacio soils are strongly alkaline. The LaSauses soil is strongly alkaline in the upper part and medium acid in the lower part. The LaJara soil is neutral to mildly alkaline. All the other soils listed in table 10 are in the moderately alkaline range. The pH value of these soils at a 1:5 soil-water dilution is about 0.5 to 1.3 higher than it is for the pH paste.

The high pH value of many of these soils is indicative of a high exchangeable sodium percentage. High exchangeable sodium also is indicated in many of these soils by a dispersed surface layer and very slow water penetration. Laboratory analyses shows that many of these soils contain more than 15 percent exchangeable sodium. Those that contain more than 15 percent exchangeable sodium are the Arena, Corlett, Hapney, Hooper, Laney, Littlebear, Nortonville, and San Luis soils. The LaSauses soil has high exchangeable sodium in the surface layer, but the percentage decreases with depth.

Many of these soils show a high electrical conductivity, which indicates a high percentage of soluble salts. Some of the soils have a high percentage of soluble salts in the surface horizon and a lower percentage in the substratum. The sand substratum in soils that have a fluctuating water table, such as the Hooper soil, commonly has a lower electrical conductivity than the surface layer and subsoil. Soils that have high electrical conductivity and a high percentage of soluble salts are the Arena, Acacio, Laney, LaSauses, and Nortonville soils. The Costilla and Space City soils have a low percentage of soluble salts.

Most of the soils show a higher percentage of organic matter in the surface layer than in the lower layers. The content of organic matter ranges mostly from 0.4 to 2.0 percent. Three soils, the LaJara, Nortonville, and Vastine soils, had a dense meadow vegetation and therefore had an organic-matter content of 4.4 to 8.9 percent in the surface layer. Two other soils, the Corlett and Space City soils, have less than 0.4 percent organic matter in the surface layer. This is because the vegetation on these two soils is very sparse.

Some of the soils have an accumulation of lime or calcium carbonate in one or more horizons below the surface. Examples of these soils are the San Arcacio, Costilla, Acacio, and Zinzer soils. All of the soils except the LaJara, Space City, and Vastine soils contain lime. This is important in the leaching process for reclaiming alkali soils, especially when sulphuric acid is used.

The cation exchange capacity is somewhat related to the clay content of the soil. Those soils having a small amount of clay, such as the Gunbarrel, Costilla, Corlett, and Space City soils, have a low exchange capacity. As the clay content increases, the exchange capacity increases, but not in proportion to the increase in clay content. Other factors affect the cation exchange capacity. A soil high in organic-matter content has a higher exchange capacity than a similar soil with low organic-matter content. A soil horizon that is high in content of lime has a comparatively low exchange capacity because lime has no exchange capacity.

GENERAL NATURE OF THE AREA

This section briefly describes the history and development of the Alamosa Area. It also discusses the geology and physiography, climate, and farming.

History and Development

The San Luis Valley, in which the Alamosa Area is located, was Spanish territory for many years. It later became a part of Mexico and was taken into the United States during the Mexican War. There was no development during the period of Spanish and Mexican occupancy, although there are legends of Spanish mines in the Sangre de Cristo Mountains and some evidence of mining activity was found by American pioneers. During the first half of the 19th century, The Area was well known to a number of frontiersmen, but no settlement was attempted.

Settling began in the Area shortly after the Civil War, and cattle ranching developed rapidly during the 1870's. During this period a few ranch headquarters were established along the Rio Grande River and at the foot of the Sangre de Cristo Range in what is now Alamosa County. Cattle were at first run yearlong over the entire valley and were gathered in large roundups in a pattern similar to that followed on the plains to the east. Severe winters caused heavy losses, however, and most of the ranches soon developed the system still generally followed, in which cattle are moved to high mountain ranges for the summer and are fed hay through much of the winter and early in spring. Most ranch property, therefore, is near natural meadows along the Rio Grande and other streams. During the period of early development, some large bands of sheep also ranged over the Area.

Ranching development and mining activities in the mountains to the west encouraged the Denver and Rio Grande Western Railroad to extend a line westward over the Sangre de Cristo Range. In 1878, this line reached the big bend of the Rio Grande River, and the town of Alamosa was established. The town soon became a thriving railroad and livestock center. Within a few years, lines were extended westward to Durango, Colorado, and the San Juan Basin; south to Santa Fe, New Mexico, up the Rio Grande to the silver mines at Creede; and north to a main line of the railroad at Salida. Shorter lines eventually served nearly all parts of the San Luis Valley.

Settlers from midwestern states came to the Mosca-Hooper area in the late 1880's. Canals were constructed to bring water from the Rio Grande River, and the growing of irrigated wheat flourished for a time. Mosca and Hooper became thriving towns.

During the 1890's there was widespread construction of canals and development of farms in the vicinity of Alamosa. Later, homesteads that depended entirely on artesian wells were taken up east and northeast of Alamosa, where stream water was not available. These wells were adequate for domestic and livestock use, but most of them were too small to develop the supply of water needed for irrigating the sandy soils. Nearly all plowed fields were soon abandoned, and the native brush returned. Most of the homesites also were abandoned within a few years.

The number of people occupying the Area was at its peak at about the time of World War I. In 1915, Alamosa County was formed from parts of Costilla and Conejos Counties. It was one of the last counties to be organized in Colorado. The county seat was located at Alamosa.

Farming has been the main incentive to development of the Area. However, there was a great deal of mining exploration in the mountains in the eastern part during the development period. Some promising leads caused a flurry of mining activity at about the turn of the century, but these mines were soon abandoned.

Geology and Physiography 7/

The San Luis Valley lies in a broad structural depression that forms the northern end of the great valley of the Rio Grande. The eastern boundary of the San Luis Valley is formed by the steep, rugged Sangre de Cristo Mountains. Sierra Blanca, the highest peak in the range, has an altitude of 14,363 feet. The San Juan Mountains, which also contain many high peaks, form the western boundary of the valley.

The floor of the San Luis Valley is relatively flat and has a topographic depression along its eastern side north of the Rio Grande. On the eastern side of the depression are numerous alluvial fans, whose heads lie at the mouths of short, precipitous canyons in the Sangre de Cristo Mountains. Streams that enter the basin from the west are much larger and have extensive drainage basins in the San Juan Mountains. They have formed much broader and more gently sloping alluvial fans. The Rio Grande alluvial fan is the most extensive fan, spreading out over the valley for a radius of nearly 20 miles from Del Norte, the point at which the Rio Grande enters the valley from the mountains to the west (22).

The Alamosa Area is located in the east-central part of the San Luis Valley. The southwestern part of the survey area is drained by the Rio Grande, which enters Alamosa County on the west and follows a southeasterly course past Alamosa to the southern boundary of the county. Alamosa and LaJara Creeks drain into the Rio Grande near the point where it leaves the county.

The rest of the survey area lies within the closed basin part of the San Luis Valley. The drainage within the closed basin is primarily into a series of small lakes--Soda, Head, and San Luis--in the north-central part of the survey area. Scattered over a fairly extensive area south of these lakes are numerous small, salt-encrusted playas that contain water only during extremely wet periods.

Altitudes within the survey area range from about 7,450 feet along the Rio Grande where it leaves the Area to about 11,000 feet on the slopes of Sierra Blanca. However, the greater part of the Area lies between the altitudes of 7,500 feet and 7,600 feet and is nearly level. It has only a few prominent physiographic features.

The northwestern part of the survey area lies across the lower end of the broad, flat Rio Grande alluvial fan. The southwestern part of the area lies across the lower end of the combined alluvial fan deposited by LaJara, Alamosa, and Rock Creeks. Gradients on all of these fans are slight. Except for the shallow valley of the Rio Grande, drainageways are seldom pronounced and are difficult to trace.

The large depression area representing the lowest part of the closed basin occupies most of the eastern part of the survey area. This depression area consists of low sand dunes surrounding numerous small depressions that contain playas or lakes. The local relief within the area seldom exceeds 20 feet. Northeast of the main depression area, at the base of the Sangre de Cristo Mountains near Mosca and Medano Passes, is an area of active sand dunes that has a relief of about 700 feet. About 36,000 acres of this area makes up the Great Sand Dunes National Monument. The southern part of the monument lies within the survey area.

Steep, coalescing alluvial fans along the western face of the Sangre de Cristo Mountains border the depression area on the east. On the southeast the depression area is bordered by an undissected plain that slopes gently southwestward away from Sierra Blanca. West of the town of Blanca, in Costilla County, this plain merges with the sand dunes of the depression area. In the southern part of the survey area, the surface of the plain lies in a terrace position about 50 feet above the flood plain of the Rio Grande

7/ By ALEX D. ELKIN, geologist, Soil Conservation Service, Denver, Colorado.

Except for a small area of granitic rocks of Precambrian age that crop out along the slopes of Sierra Blanca, the geologic formations exposed within the Alamosa Area consist of unconsolidated sediments of Late Pleistocene and Recent ages. These sediments consist mainly of sandy or gravelly alluvial fan deposits, sandy or silty wind-laid deposits, and silty or clayey playa and flood-plain deposits.

These deposits can best be described in relation to the principal physiographic features of the survey area and to the source areas of the sediments in the various parts of the survey area. The principal physiographic features of the area are (1) the Rio Grande alluvial fan, (2) the Alamosa alluvial fan, (3) the depression area, (4) the alluvial fans of the western slope of the Sangre de Cristo Mountains, and (5) the alluvial plain west of the town of Blanca.

The alluvial deposits of the lower part of the Rio Grande alluvial fan are mainly sandy and silty but contain some gravel. These sediments were derived mainly from a variety of rocks of volcanic origin that make up the central part of the San Juan Mountains. The most common rock types in the upper drainage basin of the Rio Grande are those that are rhyolitic or latitic in composition. These are acidic igneous rocks that are relatively high in silica and low in iron, calcium, and magnesium minerals.

The alluvial deposits and soils of the Alamosa alluvial fan reflect a difference in composition of source materials from those of the Rio Grande fan. Most of the drainage basin of Alamosa Creek is underlain by volcanic rocks of the Conejos Formation. These rocks are principally of quartz latite and rhyodacite composition and are somewhat more basic than the average rock in the Rio Grande drainage basin. The most outstanding feature of the Alamosa Creek drainageway is the presence in the upper part of the area of large masses of intensely altered volcanic rocks. Most of the altered rocks are soft and highly colored. Kaolin, sericite, alunite, quartz, and pyrite are the most common minerals (16). The small streams that drain from the highly altered area to Alamosa Creek have a high mineral content, and the boulders in the streambeds are coated by limonitic crusts. The occurrence of gypsiferous soils in parts of the Alamosa fan can probably be traced to the presence of large amounts of sulfide and sulfate minerals in the area of altered rock.

The surficial deposits within the depression area consist mainly of fine sand and silt that have been transported from the lower parts of the Rio Grande alluvial fan by wind and water. A large part of the area consists of low sand dunes interspersed with numerous small playa basins.

The alluvial fan deposits along the western side of the Sangre de Cristo Mountains contain materials derived from granites, gneisses, and related rocks of Precambrian age. The upper ends of the fans consist mostly of cobblestones and boulders, but their lower margins are mostly sand and fine gravel.

The alluvial materials underlying the plain west of the town of Blanca consist mainly of silt and fine to coarse sand. They were probably derived mostly from Precambrian rocks in the Sangre de Cristo Mountains.

Climate[8/]

The Alamosa Area has a climate characterized by cold winters, cool summers, low precipitation, strong winds in spring, and much sunshine. A summary of temperature and precipitation data from the Alamosa station is given in table 11.

Rainfall in the survey area is low, averaging slightly more than 6 inches at Alamosa. About 80 percent of the annual precipitation occurs from April to October, and most of this is in July and August. It falls mostly in the form of light showers from thunderstorms that form over the mountains and move into the valley during the afternoon. Most of these showers are too light to benefit growing crops. Hail frequently falls in some areas during thunderstorms, causing extensive damage to crops.

In a period of 32 years, the lowest annual precipitation recorded was 3.4 inches and the highest was 11.04 inches. During this period, 3 years had more than 10.0 inches of precipitation and 14 years had less than 6.0 inches. June is the driest month between April and October, although this is a month when crops need moisture to germinate and start growing.

Summer is characterized by most days having a maximum temperature in the middle eighties and a minimum in the low forties. The highest temperature recorded was 91° F. on three different days. The lowest recorded temperature was -50°. The average summer temperature is about 62°, and average yearly temperature is about 41°.

The average growing season is short, 93 days at Alamosa. This usually allows time for two cuttings of alfalfa. It is sufficient time for the maturing of crops grown in the Area--potatoes, barley, oats, sugar beets, peas, lettuce, cauliflower, and cabbage. The average date of the last killing frost in spring is June 4, and the average date of the first killing frost in fall is September 5. During some years, frost occurs every month. The latest killing frost in spring was recorded on July 7, and the earliest killing frost in fall was recorded on August 13. In some years, early frost in fall causes yields to be reduced. Table 12 shows the probability of freezing temperatures at Alamosa on or after given dates in spring and on or before given dates in fall.

Frost penetrates to a depth of 2 or 3 feet every year. The soil is usually frozen from mid-November to mid-March. The frost generally goes out of the soil in April.

Strong wind occurs in spring and early in summer, causing much blowing dust. The wind normally is from the southwest. It normally does not blow in

---

[8/] Tables prepared with the assistance of J.W. BERRY, climatologist for Colorado, National Weather Service, U.S. Department of Commerce.

TABLE 11.--TEMPERATURE AND PRECIPITATION, ALAMOSA AREA, COLORADO

[All data from Alamosa, Alamosa County; elevation 7,539 feet]

Month	Temperature				Precipitation				
	Average daily maximum	Average daily minimum	Two years in 10 will have at least 4 days with-- Maximum temperature equal to or higher than--	Two years in 10 will have at least 4 days with-- Minimum temperature equal to or higher than--	Average total	Two years in 10 will have-- Less than--	Two years in 10 will have-- More than--	Average number of days with cover of 1 inch or more	Average depth of snow on days with snow cover
	°F.	°F.	°F.	°F.	Inches	Inches	Inches		Inches
January----	36	-1	49	-21	0.26	0.1	0.4	10	2
February---	41	6	55	-12	.17	.1	.3	5	3
March------	49	15	61	0	.26	.1	.3	2	2
April------	59	25	70	13	.69	.2	1.1	1	3
May--------	68	33	79	23	.73	.2	1.1	(1/)	1
June-------	79	41	87	32	.49	.2	.6	0	0
July-------	83	47	88	41	1.07	.6	1.4	0	0
August-----	80	46	86	37	.98	.5	1.5	0	0
September--	75	36	83	26	.77	.2	1.3	(1/)	1
October----	64	25	74	13	.60	.2	1.2	1	4
November---	49	10	60	-8	.29	.1	.4	4	3
December---	38	0	52	-17	.25	.1	.4	9	4
Year-----	60	24	89	-28	6.56	4.9	9.0	32	3

1/ Less than one-half day. 2/ Average annual maximum. 3/ Average annual minimum.

TABLE 12.--PROBABILITIES OF LAST FREEZING TEMPERATURES IN SPRING AND FIRST IN FALL, ALAMOSA, COLORADO

[Elevation 7,539 feet]

Probability	Dates for given probability and temperature				
	16° F. or lower	20° F. or lower	24° F. or lower	28° F. or lower	32° F. or lower
Spring:					
1 year in 10 later than-------	May 6	May 13	May 20	June 6	June 17
2 years in 10 later than------	May 2	May 8	May 16	June 1	June 13
5 years in 10 later than------	April 23	April 30	May 7	May 23	June 4
Fall:					
1 year in 10 earlier than-----	October 7	September 29	September 18	September 8	August 24
2 years in 10 earlier than----	October 12	October 4	September 23	September 12	August 28
5 years in 10 earlier than----	October 20	October 12	October 1	September 20	September 5
Average number of days between last freeze in spring and first in fall-----------------	180	165	147	120	93

winter or fall, except when it precedes a storm front. Spring and summer wind does the most damage by drying out the soil and making it necessary to irrigate more frequently.

Snowfall averages about 30 inches per year. It normally comes as light snow between November and April. During winter it normally stays on the ground for several weeks at a time. Some snow that falls early in fall or late in spring melts within a few days.

Farming

Irrigated farming and ranching are the principal activities in the survey area. The number of farms and ranches has been declining in the last 25 years, and the size has been increasing. There are at present about 315 operating units, and these have an average size of 1,364 acres. Most farms are from 160 to 480 acres in size. A few large ranches occupy several thousand acres.

The main crops and the approximate acreage on which they are grown yearly are alfalfa, 30,000 acres; potatoes, 7,000 acres; barley, 10,000 acres; oats, 7,000 acres; and meadow hay, 30,000 acres. Sugar beets, lettuce, cabbage, cauliflower, and peas are among the crops grown to a lesser extent. Their total acreage is about 2,000 acres.

Ranching consists mainly of raising cattle and sheep. Many of these units are operated in conjunction with irrigated farming. Some horses are raised. Hogs are raised on some irrigated farms.

LITERATURE CITED

(1) American Association of State Highway Officials.
1961. Standard Specifications for Highway Materials and Methods of Sampling and Testing. Ed. 8, 2 v., illus.

(2) Franklin, W. T., Whitney, Robert S., Code, W. E., and Reeve, R. C.
1957. Reclamation and Management of Saline-sodium Soils, Mosca-Hooper Area, San Luis Valley. Colo. Agr. Exp. Sta., General Series Paper 667, 28 pp.

(3) Harrington, H. D.
1954. Manual of the Plants of Colorado. 666 pp., illus. Denver.

(4) Hitchcock, A. S.
1950. Manual of Grasses of the United States. U.S. Dept. Agr. Misc. Pub. 200, 1951 pp., illus.

(5) Jenny, Hans.
1941. Factors of Soil Formation. 281 pp. illus. New York and London.

(6) Kilmer, V. J., and Alexander, L. T.
1949. Methods of Making Mechanical Analyses of Soils. Soil Sci. 68: 15-24.

(7) ____________ and Mullins, J. F.
1954. Improved Stirring and Pipetting Apparatus for Mechanical Analysis of Soils. Soil Sci. 77: 437-441.

(8) Merk, G. P.
1960. Great Sand Dunes of Colorado. Guide to the Geology of Colorado: 127-129.

(9) Olmstead, L. B., Alexander, L. T., and Middleton, H. E.
1930. A Pipette Method of Mechanical Analysis of Soils Based on Improved Dispersion Procedure. U.S. Dept. Agr. Tech. Bul. 170, 22 pp., illus.

(10) Peech, Michael, Alexander, L. T., Dean, L. A., and Reed, J. Fielding.
1947. Methods of Soil Analysis for Soil-Analysis for Soil-fertility Investigations. U.S. Dept. Agr. Cir. 757, 25 pp.

(11) Powell, W. J.
1958. Ground-water Resources of the San Luis Valley, Colorado. U.S. Geol. Surv. Water-Supply Paper 1379, 284 pp.

(12) Portland Cement Association
1962. PCA Soil Primer. 86 pp., illus.

(13) Richards, L. A., Ed.
1954. Diagnosis and Improvement of Saline and Alkali Soils. U.S. Dept. of Agr. Handbook 60, 160 pp., illus.

(14) Simonson, Roy W.
1962. Soil Classification in the United States. Sci. 137: 1027-1034.

(15) Soil Survey Staff.
1960. Soil Classification, a Comprehensive System, 7th Approximation. U.S. Dept. Agr., 265 pp., illus. [Supplements issued in March 1967 and September 1968]

(16) Steven, T. A., and Ratte, J. C.
1960. Geology and Ore Deposits of the Summitville District, San Juan Mountains, Colorado. U.S. Geol. Survey Prof. Paper 343, 70 pp.

(17) United States Department of Agriculture.
1938. Soils and Men. U.S. Dept. Agr. Ybk: 1232 pp., illus.

(18) ________________.
1951. Soil Survey Manual. U.S. Dept. Agr. Handbook 18, 503 pp., illus.

(19) ________________.
1955. Water. U.S. Dept. Agr. Ybk: 120.

(20) United States Department of Defense.
1968. Unified Soil Classification System of Roads, Airfields, Embankments, and Foundations. MIL-STO-619B., 30 pp., illus.

(21) United States Department of the Interior.
1935. Geologic Map of Colorado. Geol. Survey in coop. with Colo. State Geol. Survey Bd. and Colo. Metal and Mining Fund, 2 map sheets.

(22) Upson, J. E.
1939. Physiographic Subdivisions of the San Luis Valley, Southern Colorado. Jour. of Geology, v. 47, No. 7, pp. 721-736.

GLOSSARY

Aggregate, soil. Many fine particles held in a single mass or cluster. Natural soil aggregates such as crumbs, blocks, or prisms, are called peds. Clods are aggregates produced by tillage or logging.

Alkali soil. Generally, a highly alkaline soil. Specifically, an alkali soil has so high a degree of alkalinity (pH 8.5 or higher) or so high a percentage of exchangeable sodium (15 percent or more of the total exchangeable bases), or both, that the growth of most crop plants is low from this cause.

Alluvium. Soil material, such as sand, silt, or clay, that has been deposited on land by streams.

Available water holding capacity (also termed available moisture holding capacity). The capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil.

Calcareous soil. A soil containing enough calcium carbonate (often with magnesium carbonate) to effervesce (fizz) visibly when treated with cold, dilute hydrochloric acid.

Clay film. A thin coating of clay on the surface of a soil aggregate. Synonyms: Clay coat, clay skin.

Consistence, soil. The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are--

Loose.--Noncoherent when dry or moist; does not hold together in a mass.

Friable.--When moist, crushes easily under gentle pressure between thumb and forefinger and can be pressed together into a lump.

Firm.--When moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.

Plastic.--When wet, readily deformed by moderate pressure but can be pressed into a lump; will form a "wire" when rolled between thumb and forefinger.

Sticky.--When wet, adheres to other material and tends to stretch somewhat and pull apart, rather than to pull free from other material.

Hard.--When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.

Soft.--When dry, breaks into powder or individual grains under very slight pressure.

Cemented.--Hard and brittle; little affected by moistening.

Erosion. The wearing away of the land surface by wind (sandblast), running water, and other geological agents.

Fallow. Cropland left idle in order to restore productivity, mainly through accumulation of water, nutrients, or both. Summer fallow is a common stage before cereal grain in regions of limited rainfall. The soil is tilled for at least one growing season to control weeds, to aid decomposition of plant residues, and to encourage the storage of moisture for the succeeding grain crop.

Fertility, soil. The quality of a soil that enables it to provide compounds, in adequate amounts and in proper balance, for the growth of specified plants, when other growth factors, such as light, moisture, temperature, and the physical condition of the soil are favorable.

Field moisture capacity. The moisture content of a soil, expressed as a percentage of the oven-dry weight, after the gravitational, or free, water has been allowed to drain away; the field moisture content 2 or 3 days after a soaking rain; also called normal field capacity, normal moisture capacity, or capillary capacity.

Genesis, soil. The manner in which a soil originates. Refers especially to the processes initiated by climate and organisms that are responsible for the development of the solum, or true soil, from the unconsolidated parent material, as conditioned by relief and age or landform.

Horizon, soil. A layer of soil, approximately parallel to the surface, that has distinct characteristics produced by soil-forming processes. These are the major horizons:

O horizon.--The layer of organic matter on the surface of a mineral soil. This layer consists of decaying plant residues.

A horizon.--The mineral horizon at the surface or just below an O horizon. This horizon is the one in which living organisms are most active and therefore is marked by the accumulation of humus. The horizon may have lost one or more of soluble salts, clay, and sesquioxides (iron and aluminum oxides).

B horizon.--The mineral horizon below an A horizon. The B horizon is in part a layer of change from the overlying A to the underlying C horizon. The B horizon also has distinctive characteristics caused (1) by accumulation of clay, sesquioxides, humus, or some combination of these; (2) by prismatic or blocky structure; (3) by redder or stronger colors than the A horizon; or (4) by some combination of these. Combined A and B horizons are usually called the solum, or true soil. If a soil lacks a B horizon, the A horizon alone is the solum.

C horizon.--The weathered rock material immediately beneath the solum. In most soils this material is presumed to be like that from which the overlying horizons were formed. If the material is known to be different from that in the solum, a Roman numeral precedes the letter C.

R layer.--Consolidated rock beneath the soil. The rock usually underlies a C horizon but may be immediately beneath an A or B horizon.

Irrigation. Application of water to soils to assist in production of crops. Methods of irrigation are--

Border.--Water is applied at the upper end of a strip in which the lateral flow of water is controlled by small earth ridges called border dikes, or borders.

Basin.--Water is applied rapidly to relatively level plots surrounded by levees or dikes.

Controlled flooding.--Water is released at intervals from closely spaced field ditches and distributed uniformly over the field.

Corrugation.--Water is applied to small, closely spaced furrows or ditches in fields of close-growing crops, or in orchards, to confine the flow of water to one direction.

Furrow.--Water is applied in small ditches made by cultivation implements used for tree and row crops.

Sprinkler.--Water is sprayed over the soil surface through pipes or nozzles from a pressure system.

Subirrigation.--Water is applied in open ditches or tile lines until the water table is raised enough to wet the soil.

Wild flooding.--Irrigation water, released at high points, flows onto the field without controlled distribution.

Leaching. The removal of soluble materials from soils or other material by percolating water.

Loess. A fine-grained eolian deposit consisting dominantly of silt-sized particles.

Mottled. Irregularly marked with spots of different colors that vary in number and size. Mottling in soils usually indicates poor aeration and lack of drainage. Descriptive terms are as follows: Abundance--few, common, and many; size--fine, medium, and coarse; and contrast--faint, distinct, and prominent. The size measurements are these: fine, less than 5 millimeters (about 0.2 inch) in diameter along the greatest dimension; medium, ranging from 5 millimeters to 15 millimeters (about 0.2 to 0.6 inch) in diameter along the greatest dimension; and coarse, more than 15 millimeters (about 0.6 inch) in diameter along the greatest dimension.

Natural soil drainage. Refers to the conditions of frequency and duration of periods of saturation or partial saturation that existed during the development of the soil, as opposed to altered drainage, which is commonly the result of artificial drainage or irrigation but may be caused by the sudden deepening of channels or the blocking of drainage outlets. Seven different classes of natural soil drainage are recognized.

Excessively drained soils are commonly very porous and rapidly permeable and have a low water-holding capacity.

Somewhat excessively drained soils are also very permeable and are free from mottling throughout their profile.

Well-drained soils are nearly free from mottling and are commonly of intermediate texture.

Moderately well drained soils commonly have a slowly permeable layer in or immediately beneath the solum. They have uniform color in the A and upper B horizons and have mottling in the lower B and the C horizons.

Imperfectly or somewhat poorly drained soils are wet for significant periods but not all the time, and in Podzolic soils commonly have mottlings below 6 to 16 inches, in the lower A horizon and in the B and C horizons.

Poorly drained soils are wet for long periods and are light gray and generally mottled from the surface downward, although mottling may be absent or nearly so in some soils.

Very poorly drained soils are wet nearly all the time. They have a dark-gray or black surface layer and are gray or light gray, with or without mottling, in the deeper parts of the profile.

Permeability. The quality of a soil horizon that enables water or air to move through it. Terms used to describe permeability are as follows: Very slow, slow, moderately slow, moderate, moderately rapid, rapid, and very rapid.

pH value. A numerical means for designating relatively weak acidity and alkalinity in soils. A pH value of 7.0 indicates precise neutrality; a higher value alkalinity; and a lower value, acidity.

Profile, soil. A vertical section of the soil through all its horizons and extending into the parent material.

Reaction, soil. The degree of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is precisely neutral in reaction because it is neither acid nor alkaline. An acid, or "sour," soil is one that gives an acid reaction. In words, the degrees of acidity or alkalinity are expressed thus:

	pH
Extremely acid	Below 4.5
Very strongly acid	4.5 to 5.0
Strongly acid	5.1 to 5.5
Medium acid	5.6 to 6.0
Slightly acid	6.1 to 6.5
Neutral	6.6 to 7.3
Mildly alkaline	7.4 to 7.8
Moderately alkaline	7.9 to 8.4
Strongly alkaline	8.5 to 9.0
Very strongly alkaline	9.1 and higher

Relief. The elevations or inequalities of a land surface, considered collectively.

Rotation grazing. Grazing two or more pastures, or parts of a range, in regular order, with definite recovery periods between grazing periods. Contrasts with continuous grazing.

Saline soil. A soil that contains soluble salts in amounts that impair growth of plants but that does not contain excess exchangeable sodium.

Soil. A natural, three-dimensional body on the earth's surface that supports plants and that has properties resulting from the integrated effect of climate and living matter acting on earthy parent material, as conditioned by relief over periods of time.

Soil separates. Mineral particles, less than 2 millimeters in equivalent diameter and ranging between specified size limits. The names and sizes of separates recognized in the United States are as follows: Very coarse sand (2.0 to 1.0 millimeter); coarse sand (1.0 to 0.5 millimeter); medium sand (0.5 to 0.25 millimeter); fine sand (0.25 to 0.10 millimeter); very fine sand (0.10 to 0.05 millimeter); silt (0.05 to 0.002 millimeter); and clay (less than 0.002 millimeter). The separates recognized by the International Society of Soil Science are as follows: I (2.0 to 0.2 millimeters); II (0.2 to 0.02 millimeter); III (0.2 to 0.002 millimeter); IV (less than 0.002 millimeter).

Solum. The upper part of a soil profile, above the parent material, in which the processes of soil formation are active. The solum in mature soil includes the A and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the underlying material. The living roots and other plant and animal life characteristic of the soil are largely confined to the solum.

Structure, soil. The arrangement of primary soil particles into compound particles or clusters that are separated from adjoining aggregates and have properties unlike those of an equal mass of unaggregated primary soil particles. The principal forms of soil structure are--platy (laminated), prismatic (vertical axis of aggregates longer than horizontal), columnar (prisms with rounded tops), blocky (angular or subangular), and granular. Structureless soils are (1) single grain (each grain by itself, as in dune sand) or (2) massive (the particles adhering together without any regular cleavage, as in many claypans and hardpans).

Subsoil. Technically, the B horizon; roughly, the part of the solum below plow depth.

Surface soil. The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, about 5 to 8 inches in thickness. The plowed layer.

Terrace. An embankment, or ridge, constructed across sloping soils on the contour or at a slight angle to the contour. The terrace intercepts surplus runoff so that it may soak into the soil or flow slowly to a prepared outlet without harm. Terraces in fields are generally built so they can be farmed. Terraces intended mainly for drainage have a deep channel that is maintained in permanent sod.

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportions of fine particles, are sand, loamy sand, sandy loam, loam, silt loam, silt, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay, and clay. The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine."

Tilth, soil. The condition of the soil in relation to the growth of plants, especially soil structure. Good tilth refers to the friable state and is associated with high noncapillary porosity and stable, granular structure. A soil in poor tilth is nonfriable, hard, nonaggregated, and difficult to till.

GUIDE TO MAPPING UNITS

For a full description of a mapping unit, read both the description of the mapping unit and that of the soil series to which the mapping unit belongs. In referring to a capability unit or range site, read the introduction to the section it is in for general information about its management. Other information is given in tables as follows:

Acreage and extent, table 1, p. 11.
Predicted yields, table 2, p. 52.
Suitability of soils for wildlife, table 3, p. 58.
Soil interpretations for recreation, table 4, p. 59.
Engineering uses of the soils, tables 5, 6, and 7, pages 66 through 97.

Map symbol	Mapping unit	Described on page	Capability unit: Irrigated Symbol	Irrigated Page	Capability unit: Nonirrigated Symbol	Nonirrigated Page	Range Name	Range Page
AaA	Acacio loam, 0 to 1 percent slopes------	12	IIIs-1	42	VIIs-3	49	Salt Flats	55
AaB	Acacio loam, 1 to 3 percent slopes------	12	IIIe-1	41	VIIs-3	49	Salt Flats	55
AcA	Acacio loam, saline, 0 to 1 percent slopes-------------------------------	12	IIIsw-1	42	VIw-2	48	Salt Flats	55
Am	Alamosa loam----------------------------	13	IIIw-1	44	Vw-1	47	Wet Meadow	54
An	Alamosa loam, saline--------------------	13	IIIw-2	45	VIw-1	47	Salt Meadow	54
Ar	Arena loam------------------------------	14	IIIsw-1	42	VIw-2	48	Salt Flats	55
As	Arena loam, drained---------------------	14	IIIw-1	44	VIw-2	48	Salt Flats	55
CmF	Comodore extremely rocky loam, 40 to 150 percent slopes--------------------	15	-------	--	VIIIs-1	51	------------	--
CoE	Corlett sand, hilly---------------------	16	-------	--	VIIe-3	48	Sand Hummocks	55
CpB	Corlett-Hooper complex, undulating------	16						
	Corlett sand-----------------------	--	-------	--	VIIs-5	50	Sand Hummocks	55
	Hooper loamy sand------------------	--	-------	--	VIIs-5	50	Salt Flats	55
	Hooper clay loam-------------------	--	-------	--	VIIs-5	50	-------------	--
CsA	Costilla loamy sand, 0 to 2 percent slopes-------------------------------	17	IVe-1	45	VIIe-1	48	Sandy Bench	56
CtE	Cotopaxi sand, hilly--------------------	17	-------	--	VIIe-2	48	Deep Sand	56
Du	Dune land-------------------------------	17	-------	--	VIIIe-1	51	-------------	--
GgA	Graypoint-Gravelly land complex, 0 to 2 percent slopes---------------------	18	IVs-2	46	VIIs-4	50	-------------	--
Gn	Gunbarrel loamy sand--------------------	19	IVe-1	45	VIIe-4	48	Salt Flats	55
Gs	Gunbarrel loamy sand, saline------------	19	IVew-1	45	VIIe-4	48	Salt Flats	55
Ha	Hapney loam-----------------------------	20	IVs-1	46	VIIs-6	50	Salt Flats	55
Hm	Homelake loam---------------------------	20	IIIw-1	44	Vw-1	47	Wet Meadow	54
Ho	Hooper loamy sand-----------------------	21	VIs-1	47	VIIs-5	50	Salt Flats	55
Hp	Hooper clay loam------------------------	21	-------	--	VIIs-4	50	-------------	--
Hs	Hooper soils, occasionally flooded------	21	-------	--	VIIw-2	50	Alkali Overflow	54
La	LaJara loam-----------------------------	22	IVw-1	47	Vw-1	47	Wet Meadow	54
Le	Laney loam------------------------------	23	IIIsw-1	42	VIIs-3	49	Salt Flats	55
Ls	LaSauses sandy clay loam----------------	24	IVsw-1	46	VIw-2	48	Salt Flats	55
LtC	Littlebear sandy loam, 3 to 6 percent slopes-------------------------------	25	-------	--	VIIe-4	48	Valley Sand	55
Lu	Loamy alluvial land---------------------	25	IIIw-1	44	Vw-1	47	Wet Meadow	54
Ma	Marsh-----------------------------------	25	-------	--	VIIIw-1	51	---------------	--
Mc	McGinty sandy loam----------------------	26	IIIs-3	43	VIIs-3	49	Salt Flats	55
Mg	McGinty sandy loam, saline--------------	26	IIIsw-3	43	VIw-2	48	Salt Flats	55
Mn	Medano fine sandy loam------------------	26	IVw-1	47	Vw-1	47	Wet Meadow	54
Mo	Mosca loamy sand------------------------	27	IIIe-2	41	VIIe-4	48	Valley Sand	55
Ms	Mosca loamy sand, wet-------------------	27	IIIew-2	42	VIw-2	48	Salt Flats	55
MtD	Mount Home-Saguache cobbly sandy loams, 4 to 12 percent slopes----------------	28	-------	--	VIIs-1	49	Foothill Sand	56
No	Nortonville loam------------------------	29	IIIw-2	45	VIw-1	47	Salt Meadow	54
Pe	Peat------------------------------------	29	-------	--	Vw-1	47	---------------	--
Sa	San Arcacio sandy loam------------------	30	IIIs-2	43	VIIs-3	49	Salt Flats	55
Sc	San Arcacio sandy loam, saline----------	30	IIIsw-2	43	VIw-2	48	Salt Flats	55
Sd	Sandy alluvial land---------------------	31	IVs-2	46	VIIw-1	50	---------------	--
Se	San Luis sandy loam---------------------	31	IIIsw-5	44	VIw-2	48	Salt Flats	55
Sf	San Luis sandy loam, drained------------	32	IIIsw-4	44	VIw-2	48	Salt Flats	55

Map symbol	Mapping unit	Described on page	Capability unit				Range	
			Irrigated		Nonirrigated			
			Symbol	Page	Symbol	Page	Name	Page
SlB	San Luis-Corlett complex, undulating----	32						
	San Luis sandy loam-----------------	--	-------	--	VIw-2	48	Salt Flats	55
	Corlett sand-----------------------	--	-------	--	VIw-2	48	Sand Hummocks	55
Sm	San Luis-Gravelly land complex----------	32						
	San Luis sandy loam, drained--------	--	IVs-2	46	VIIs-4	50	Salt Flats	55
	Gravelly land-----------------------	--	IVs-2	46	VIIs-4	50	---------------	--
SpB	Space City loamy fine sand, 0 to 3 percent slopes------------------------	33	IVe-1	45	VIIe-1	48	Sandy Bench	56
SrB	Space City loamy fine sand, alkali substratum, 0 to 3 percent slopes-----	33	IVe-1	45	VIIe-4	48	Valley Sand	55
StE	Space City-Hooper complex, hilly--------	33						
	Space City loamy fine sand, alkali substratum-----------------------	--	-------	--	VIIe-4	48	Valley Sand	55
	Hooper loamy sand-------------------	--	-------	--	VIIe-4	48	Salt Flats	55
	Hooper clay loam--------------------	--	-------	--	VIIe-4	48	---------------	--
UrF	Uracca very cobbly loam, 15 to 35 percent slopes------------------------	34	-------	--	VIIs-2	49	---------------	--
Va	Vastine loam---------------------------	35	IIIw-1	44	Vw-1	47	Wet Meadow	54
VgA	Villa Grove sandy clay loam, 0 to 1 percent slopes------------------------	35	IIIs-1	42	VIIs-3	49	Salt Flats	55
VlA	Villa Grove sandy clay loam, saline, 0 to 1 percent slopes-----------------	35	IIIsw-1	42	VIw-2	48	Salt Flats	55
VlB	Villa Grove sandy clay loam, saline, 1 to 3 percent slopes-----------------	36	IIIew-1	41	VIw-2	48	Salt Flats	55
Wa	Wet alluvial land----------------------	36	IIIw-2	45	VIw-1	47	Salt Meadow	54
ZnA	Zinzer loam, 0 to 1 percent slopes------	37	IIIs-1	42	VIIs-3	49	Salt Flats	55
ZnB	Zinzer loam, 1 to 3 percent slopes------	37	IIIe-1	41	VIIs-3	49	Salt Flats	55
ZoA	Zinzer loam, saline, 0 to 1 percent slopes-------------------------------	37	IIIsw-1	42	VIw-2	48	Salt Flats	55

Accessibility Statement

This document is not accessible by screen-reader software. The Natural Resources Conservation Service (NRCS) is committed to making its information accessible to all of its customers and employees. If you are experiencing accessibility issues and need assistance, please contact our Helpdesk by phone at (800) 457-3642 or by e-mail at ServiceDesk-FTC@ftc.usda.gov. For assistance with publications that include maps, graphs, or similar forms of information, you may also wish to contact our State or local office. You can locate the correct office and phone number at http://offices.sc.egov.usda.gov/locator/app.

Nondiscrimination Statement

Nondiscrimination Policy

The U.S. Department of Agriculture (USDA) prohibits discrimination against its customers, employees, and applicants for employment on the basis of race, color, national origin, age, disability, sex, gender identity, religion, reprisal, and where applicable, political beliefs, marital status, familial or parental status, sexual orientation, whether all or part of an individual's income is derived from any public assistance program, or protected genetic information. The Department prohibits discrimination in employment or in any program or activity conducted or funded by the Department. (Not all prohibited bases apply to all programs and/or employment activities.)

To File an Employment Complaint

If you wish to file an employment complaint, you must contact your agency's EEO Counselor (http://directives.sc.egov.usda.gov/33081.wba) within 45 days of the date of the alleged discriminatory act, event, or personnel action. Additional information can be found online at http://www.ascr.usda.gov/complaint_filing_file.html.

To File a Program Complaint

If you wish to file a Civil Rights program complaint of discrimination, complete the USDA Program Discrimination Complaint Form, found online at http://www.ascr.usda.gov/complaint_filing_cust.html or at any USDA office, or call (866) 632-9992 to request the form. You may also write a letter containing all of the information requested in the form. Send your completed complaint form or letter by mail to U.S. Department of Agriculture; Director, Office of Adjudication; 1400 Independence Avenue, S.W.; Washington, D.C. 20250-9419; by fax to (202) 690-7442; or by email to program.intake@usda.gov.

Persons with Disabilities

If you are deaf, are hard of hearing, or have speech disabilities and you wish to file either an EEO or program complaint, please contact USDA through the Federal Relay Service at (800) 877-8339 or (800) 845-6136 (in Spanish).

If you have other disabilities and wish to file a program complaint, please see the contact information above. If you require alternative means of communication for

program information (e.g., Braille, large print, audiotape, etc.), please contact USDA's TARGET Center at (202) 720-2600 (voice and TDD).

Supplemental Nutrition Assistance Program

For additional information dealing with Supplemental Nutrition Assistance Program (SNAP) issues, call either the USDA SNAP Hotline Number at (800) 221-5689, which is also in Spanish, or the State Information/Hotline Numbers (http://directives.sc.egov.usda.gov/33085.wba).

All Other Inquiries

For information not pertaining to civil rights, please refer to the listing of the USDA Agencies and Offices (http://directives.sc.egov.usda.gov/33086.wba).

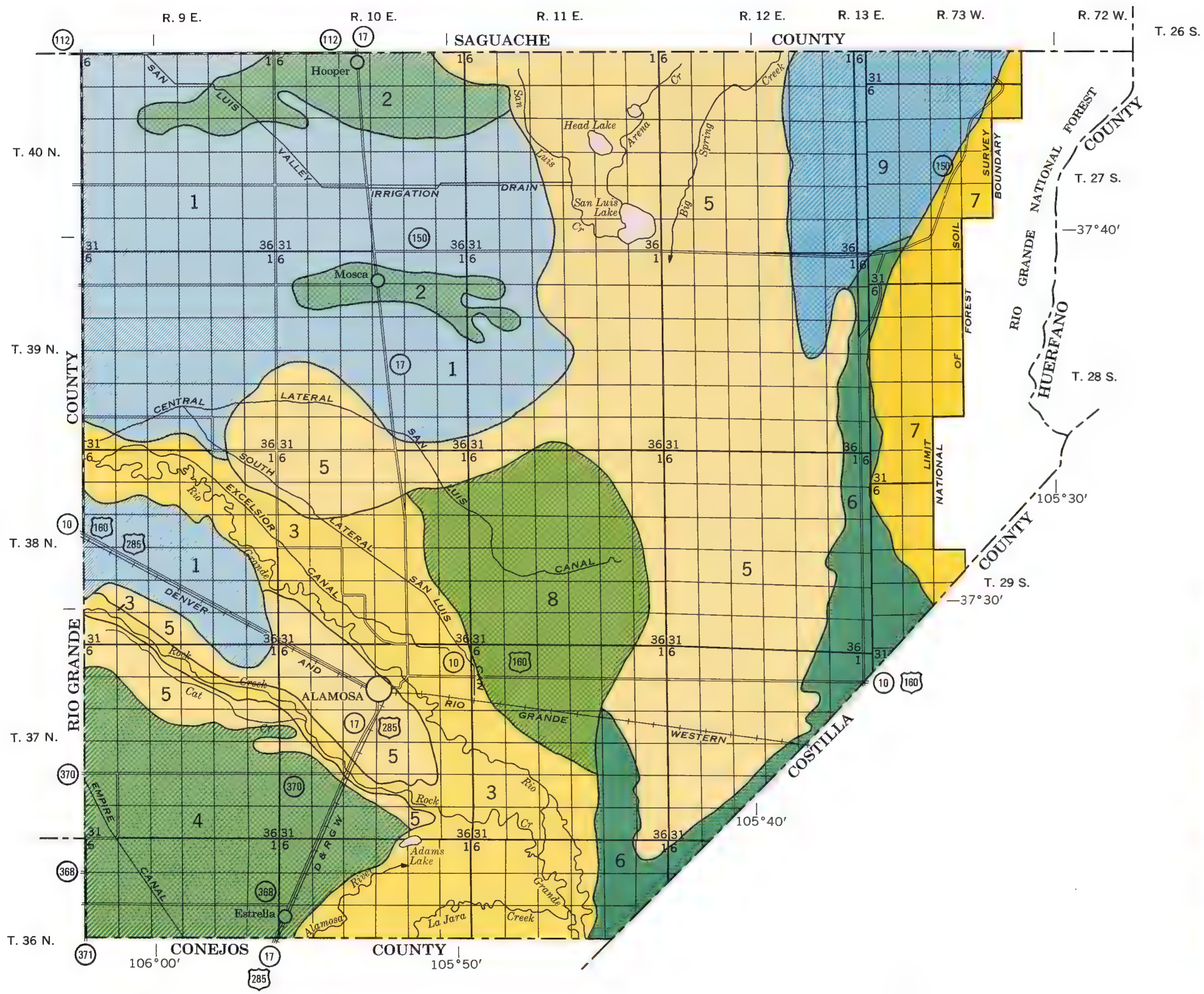
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

COLORADO AGRICULTURAL EXPERIMENT STATION

GENERAL SOIL MAP

ALAMOSA AREA, COLORADO

Scale 1:253 440



SOIL ASSOCIATIONS *

1	Gunbarrel-Mosca-San Luis association: Deep, nearly level, well-drained to poorly drained, coarse textured to moderately coarse textured soils
2	McGinty-Gunbarrel association: Deep, nearly level, well-drained and somewhat poorly drained, moderately coarse textured to coarse textured soils
3	Alamosa-Vastine-Alluvial land association: Deep, nearly level, moderately well drained to poorly drained, moderately fine textured to coarse-textured soils
4	San Arcacio-Acacio-Zinzer association: Nearly level to gently sloping, moderately well drained and well drained, moderately coarse textured and medium-textured soils; some moderately deep over gravel and sand, others deep
5	Hooper-Corlett association: Deep, nearly level to hummocky, well-drained and somewhat excessively drained, moderately fine textured to coarse-textured soils that are strongly affected by alkali
6	Costilla-Space City association: Deep, nearly level to gently sloping, somewhat excessively drained, coarse-textured soils
7	Uracca-Mount Home-Comodore association: Deep to very shallow, sloping to very steep, somewhat excessively drained and well-drained, medium-textured and moderately coarse textured, very cobbly and stony soils
8	Hapney-Hooper-Corlett association: Deep, nearly level to hilly, moderately well drained to somewhat excessively drained, moderately fine textured to coarse-textured alkali soils
9	Cotopaxi-Dune land association: Deep, rolling to hilly, excessively drained, coarse-textured soils

* Texture refers to the surface layer of the major soils unless otherwise stated.

Compiled 1972

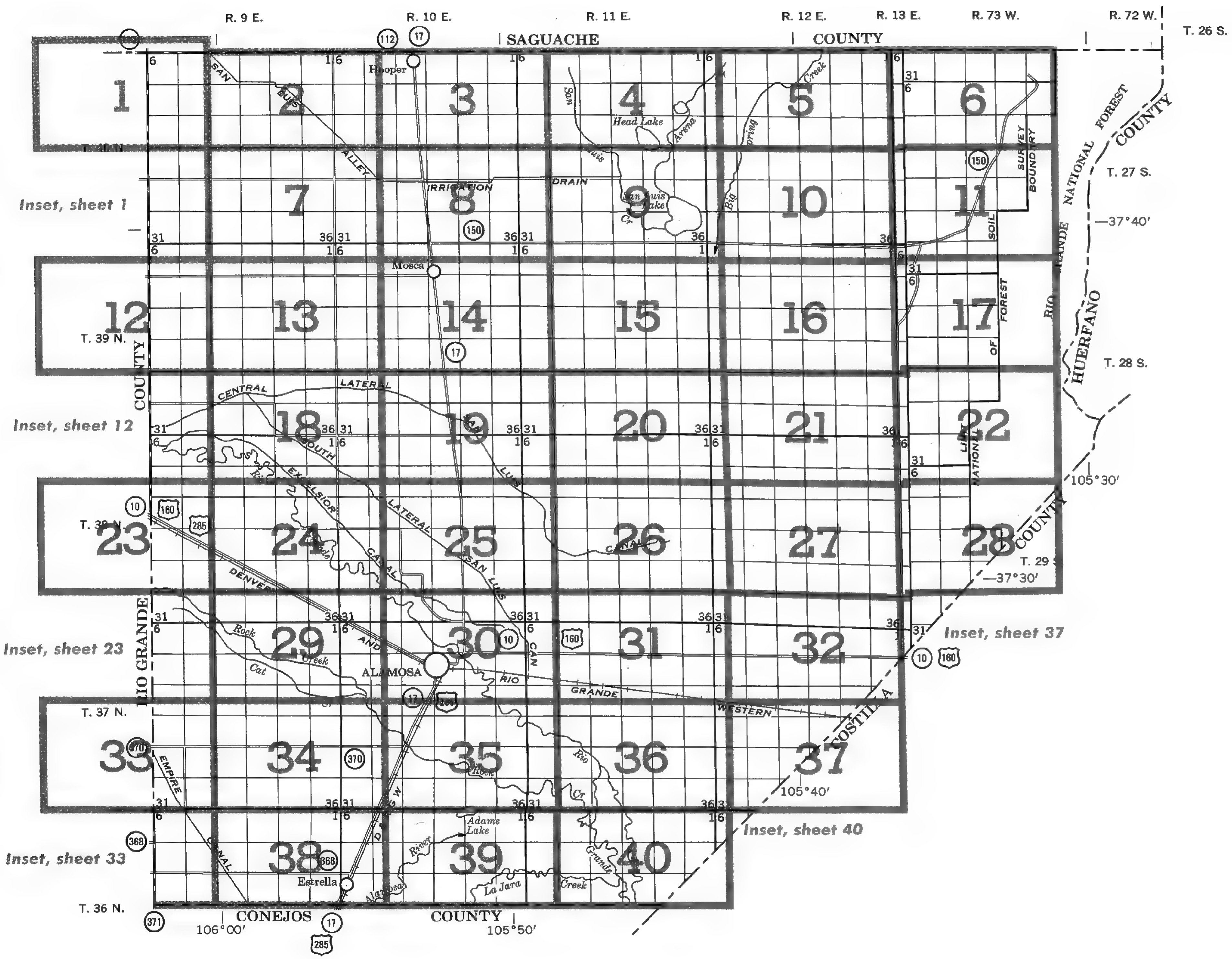
This map is for general planning. It shows only the major soils and does not contain sufficient detail for operational planning.

INDEX TO MAP SHEETS

ALAMOSA AREA, COLORADO

Scale 1 : 253 440

1 0 1 2 3 4 Miles



SOIL LEGEND

The first capital letter is the initial one of the soil name. A second capital letter, A, B, C, D, E, or F, is a general guide to the slope class. Most symbols without a slope letter are those of nearly level soils, but some are for land types that have a considerable range of slope.

SYMBOL	NAME
AaA	Acacio loam, 0 to 1 percent slopes
AaB	Acacio loam, 1 to 3 percent slopes
AcA	Acacio loam, saline, 0 to 1 percent slopes
Am	Alamosa loam
An	Alamosa loam, saline
Ar	Arena loam
As	Arena loam, drained
CmF	Comodore extremely rocky loam, 40 to 150 percent slopes
CoE	Corlett sand, hilly
CpB	Corlett-Hooper complex, undulating
CsA	Costilla loamy sand, 0 to 2 percent slopes
CtE	Cotopaxi sand, hilly
Du	Dune land
GgA	Graypoint-Gravelly land complex, 0 to 2 percent slopes
Gn	Gunbarrel loamy sand
Gs	Gunbarrel loamy sand, saline
Ha	Hapney loam
Hm	Homelake loam
Ho	Hooper loamy sand
Hp	Hooper clay loam
Hs	Hooper soils, occasionally flooded
La	LaJara loam
Le	Laney loam
Ls	LaSauses sandy clay loam
LtC	Littlebear sandy loam, 3 to 6 percent slopes
Lu	Loamy alluvial land
Ma	Marsh
Mc	McGinty sandy loam
Mg	McGinty sandy loam, saline
Mn	Medano fine sandy loam
Mo	Mosca loamy sand
Ms	Mosca loamy sand, wet
MtD	Mount Home-Saguache cobbly sandy loams, 4 to 12 percent slopes
No	Nortonville loam
Pe	Peat
Sa	San Arcacio sandy loam
Sc	San Arcacio sandy loam, saline
Sd	Sandy alluvial land
Se	San Luis sandy loam
Sf	San Luis sandy loam, drained
SlB	San Luis-Corlett complex, undulating
Sm	San Luis-Gravelly land complex
SpB	Space City loamy fine sand, 0 to 3 percent slopes
SrB	Space City loamy fine sand, alkali substratum, 0 to 3 percent slopes
StE	Space City-Hooper complex, hilly
UrF	Uracca very cobbly loam, 15 to 35 percent slopes
Va	Vastine loam
VgA	Villa Grove sandy clay loam, 0 to 1 percent slopes
VlA	Villa Grove sandy clay loam, saline, 0 to 1 percent slopes
VlB	Villa Grove sandy clay loam, saline, 1 to 3 percent slopes
Wa	Wet alluvial land
ZnA	Zinzer loam, 0 to 1 percent slopes
ZnB	Zinzer loam, 1 to 3 percent slopes
ZoA	Zinzer loam, saline, 0 to 1 percent slopes

CONVENTIONAL SIGNS

WORKS AND STRUCTURES

Highways and roads
- Dual
- Good motor
- Poor motor
- Trail

Highway markers
- National Interstate
- U. S.
- State or county

Railroads
- Single track
- Multiple track
- Abandoned

Bridges and crossings
- Road
- Trail
- Railroad
- Ferry (FY)
- Ford (FORD)
- Grade
- R. R. over
- R. R. under

Tunnel

Buildings

School

Church

Mine and quarry

Gravel pit (G.P.)

Power line

Closed tile drain

Cemetery

Dams

Levee

Tanks

Well, oil or gas

Forest fire or lookout station

Airway beacon

BOUNDARIES

- National or state
- County
- Minor civil division
- Reservation
- Land grant
- Small park, cemetery, airport
- Land survey division corners

DRAINAGE

Streams, double-line
- Perennial
- Intermittent

Streams, single-line
- Perennial
- Intermittent, unclassified

Canals and ditches

Lakes and ponds
- Perennial (water, w)
- Intermittent (int)

Spring

Marsh or swamp

Wet spot

Drainage end or alluvial fan

Well, irrigation

Well, artesian

RELIEF

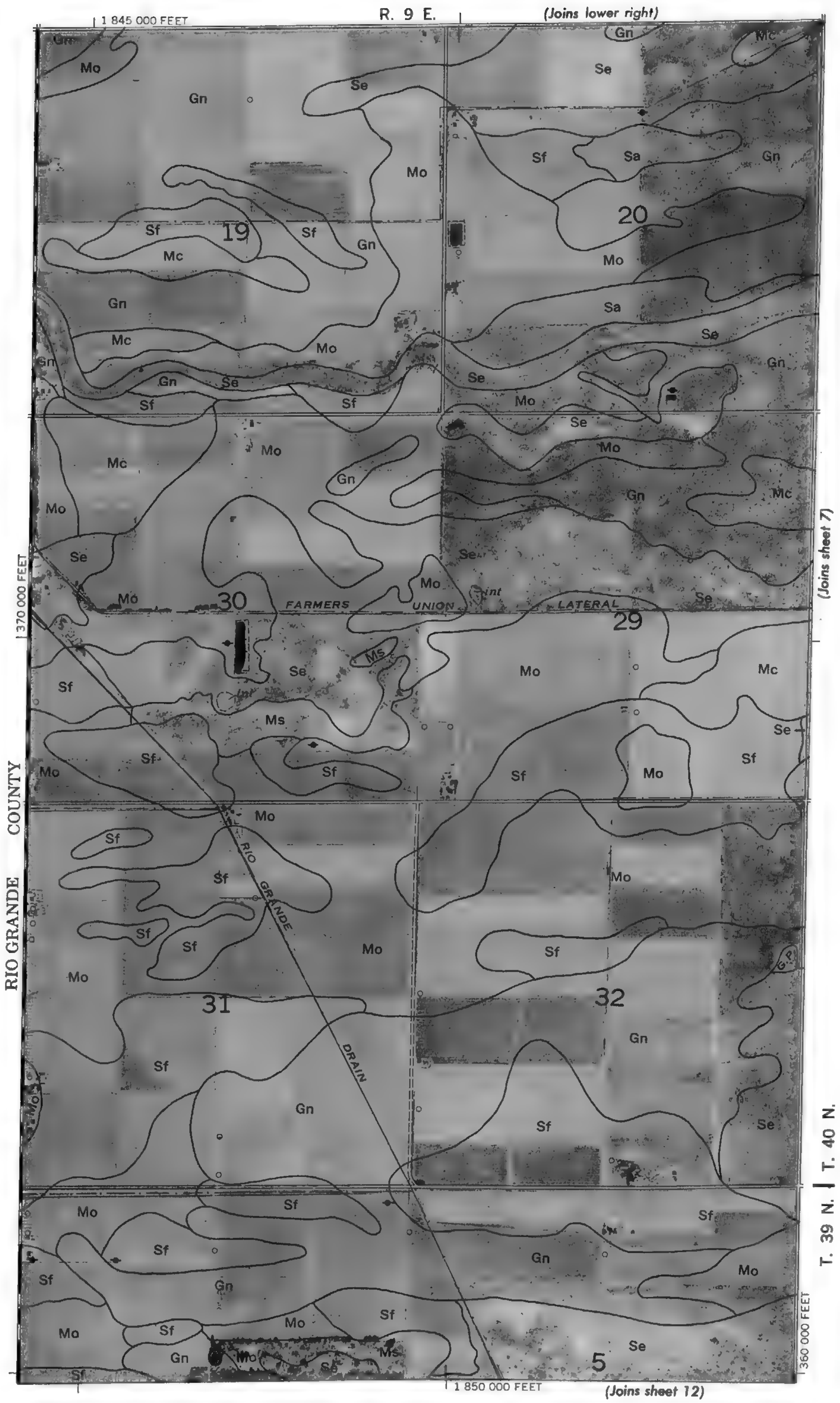
Escarpments
- Bedrock
- Other

Prominent peak

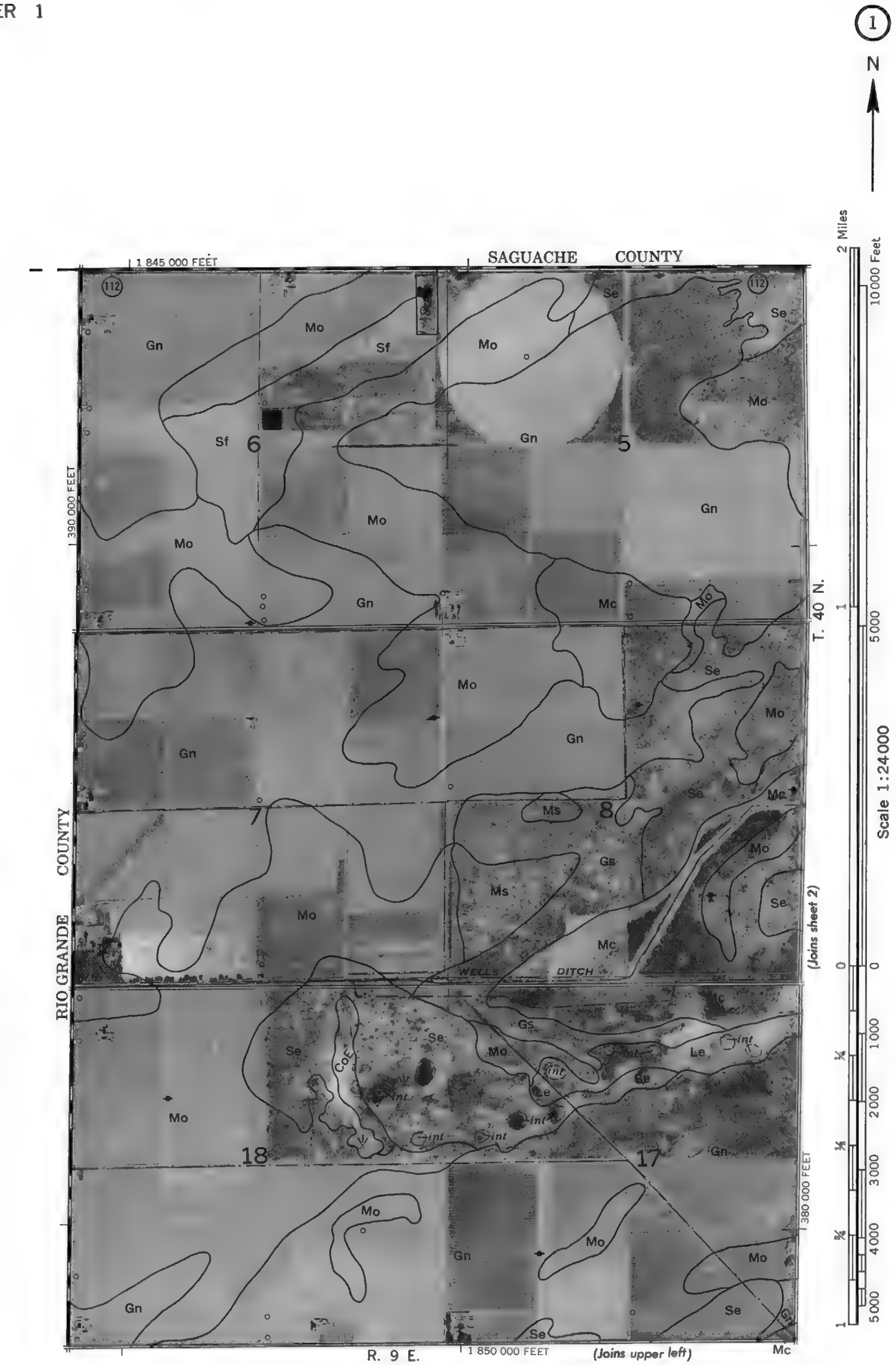
Depressions (Large, Small)
- Crossable with tillage implements
- Not crossable with tillage implements
- Contains water most of the time

SOIL SURVEY DATA

- Soil boundary and symbol (Dx)
- Gravel
- Stoniness: Stony, Very stony
- Rock outcrops
- Chert fragments
- Clay spot
- Sand spot
- Gumbo or scabby spot
- Made land
- Severely eroded spot
- Blowout, wind erosion
- Gully
- Short steep slope
- Saline or alkali spot



5000 AND 10000-FOOT GRID TICKS

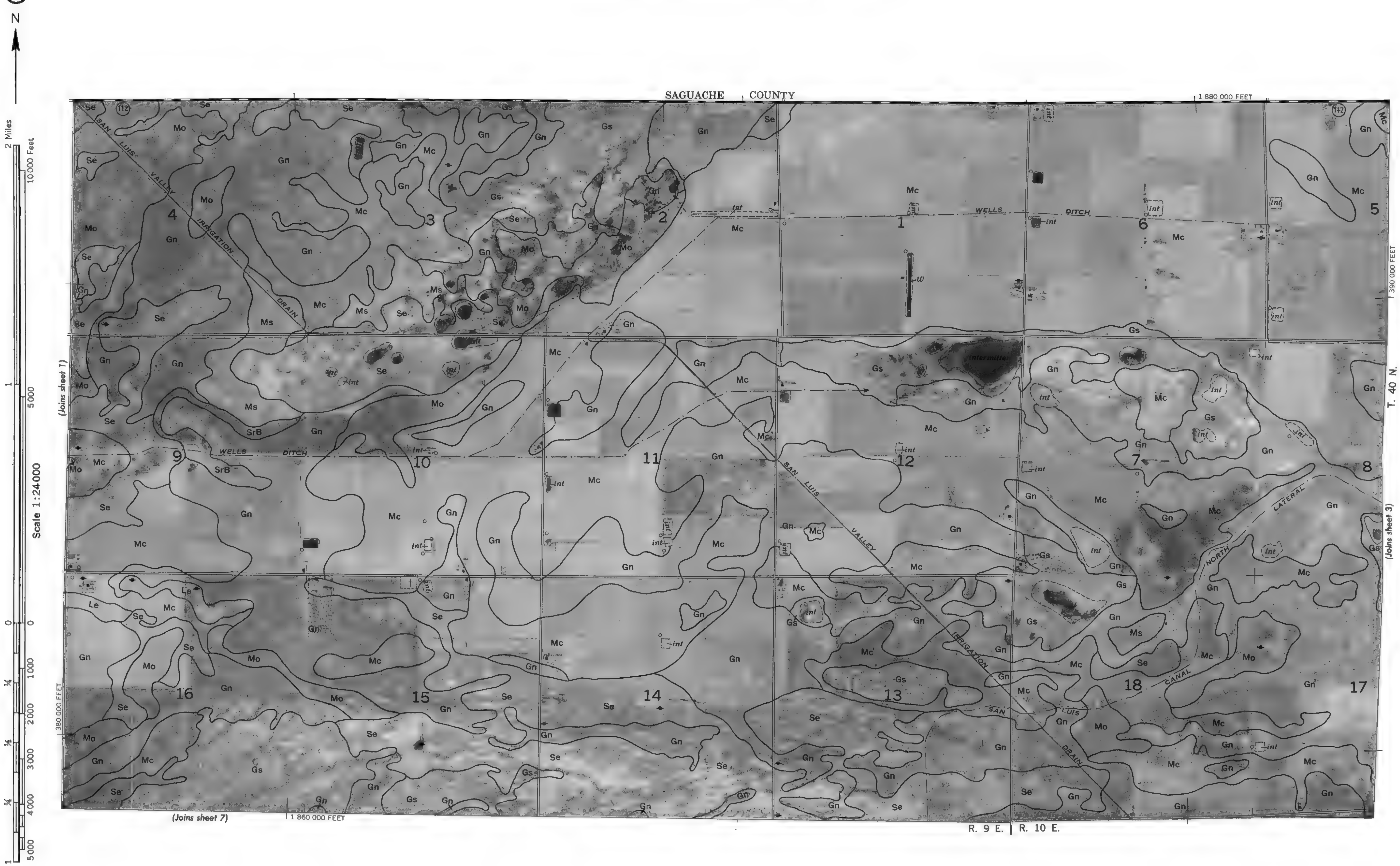


5000 AND 10000-FOOT GRID TICKS

This map is one of a set compiled in 1971 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, in cooperation with the Colorado Experiment Station.
Photobase from 1969 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the Colorado coordinate system, south zone.
Land division corners are approximately positioned on this map.

ALAMOSA AREA, COLORADO NO. 1

ALAMOSA AREA, COLORADO — SHEET NUMBER 2



ALAMOSA AREA, COLORADO NO. 2

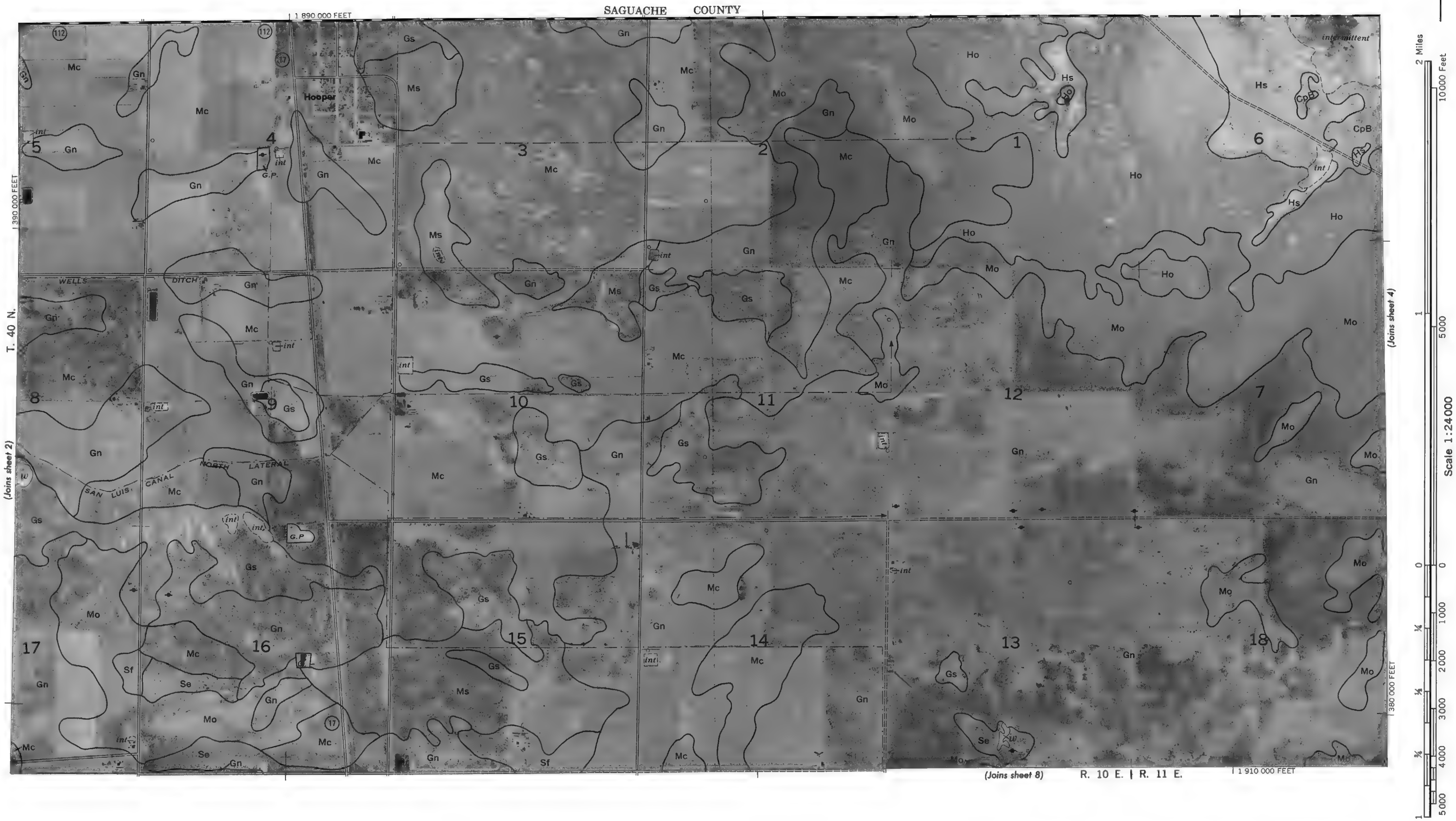
Land division corners are approximately positioned on this map.

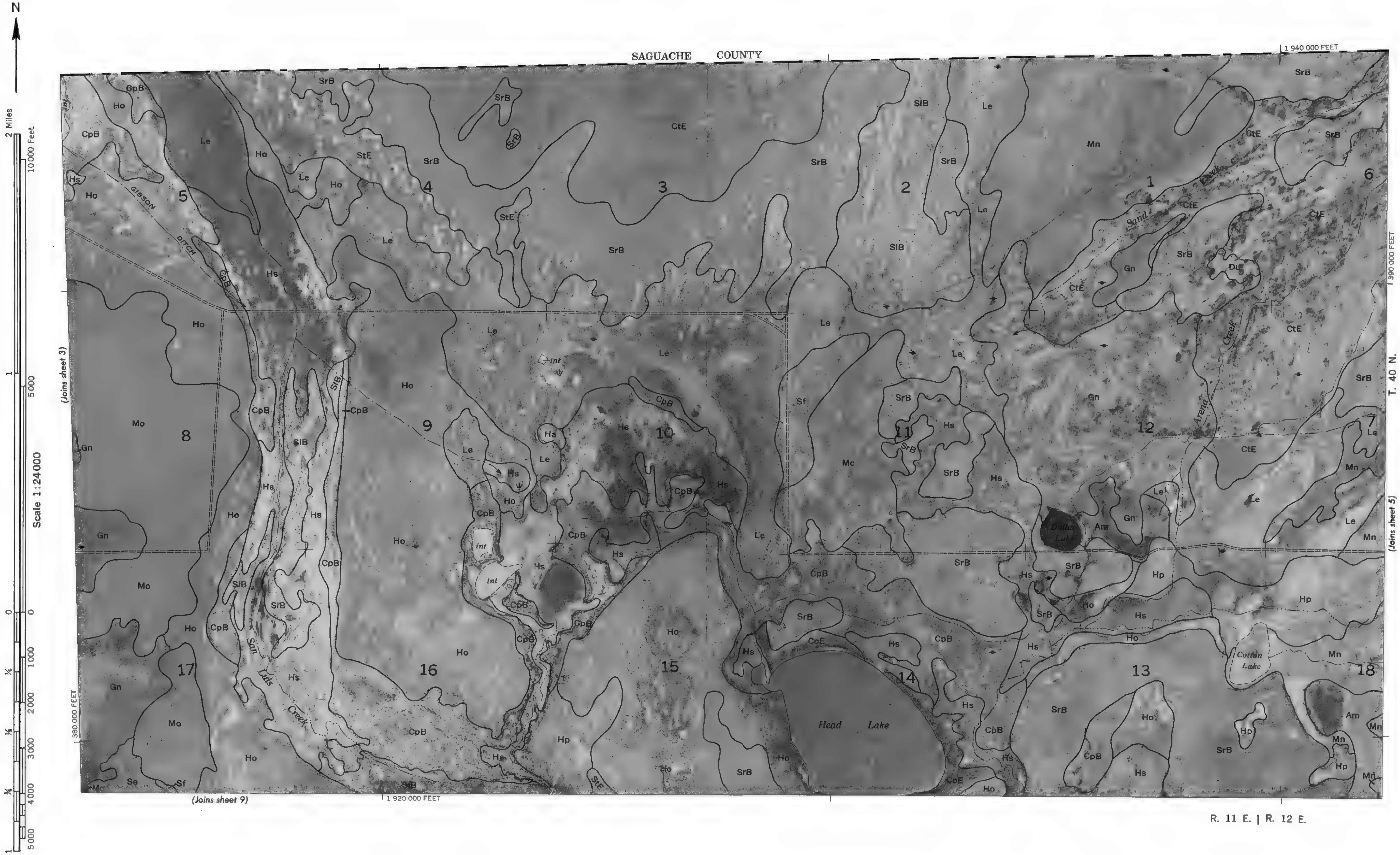
Photobase from 1969 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the Colorado coordinate system, south zone.

This map is one of a set compiled in 1971 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, in cooperation with the Colorado Experiment Station.

This map is one of a set compiled in 1971 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, in cooperation with the Colorado Experiment Station.
Photobase from 1969 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the Colorado coordinate system, south zone.
Land division corners are approximately positioned on this map.

ALAMOSA AREA, COLORADO NO. 3





ALAMOSA AREA, COLORADO NO. 4

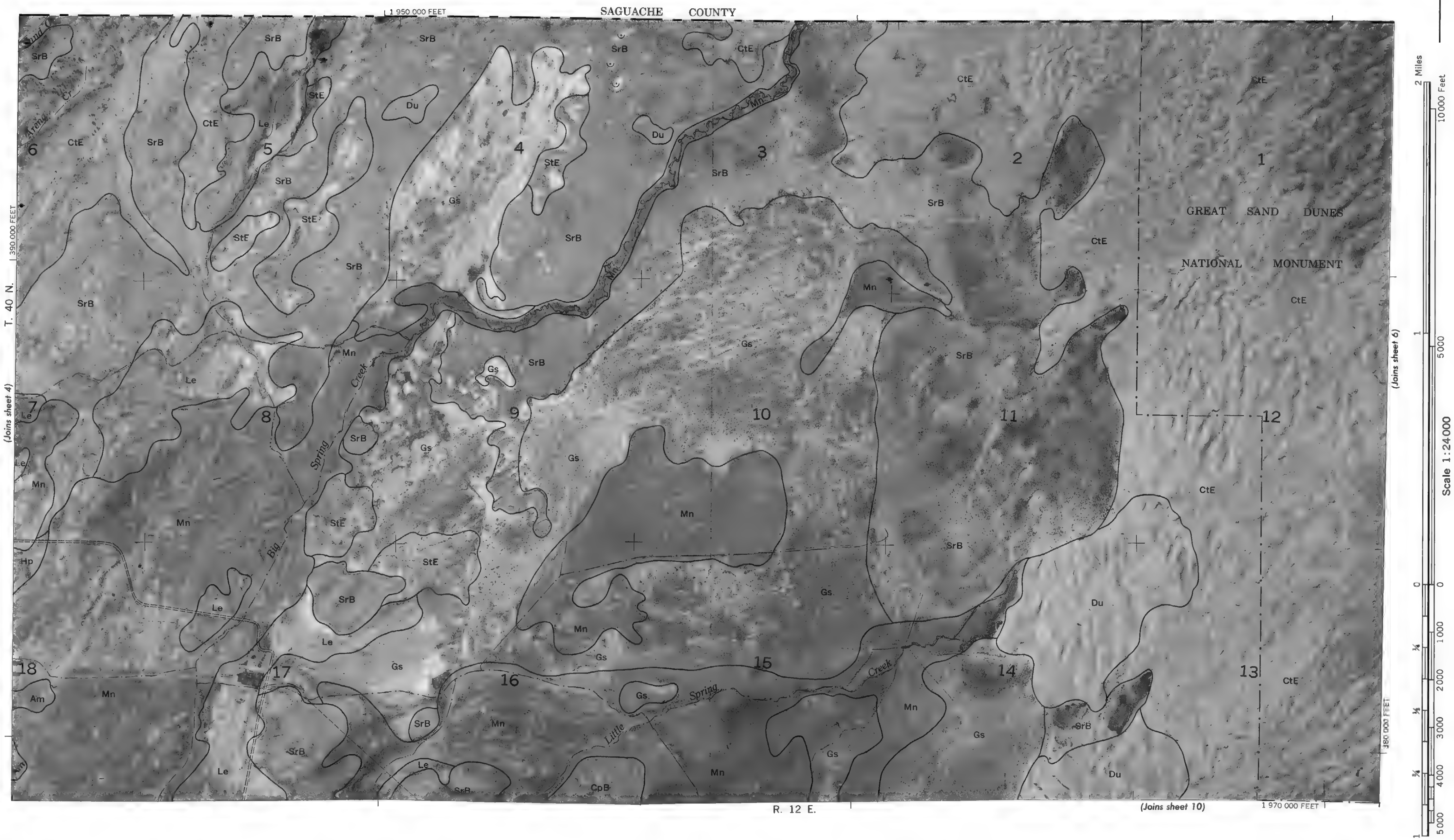
Land division corners are approximately positioned on this map.

Photobase from 1969 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the Colorado coordinate system, south zone.

This map is one of a set compiled in 1971 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, in cooperation with the Colorado Experiment Station.

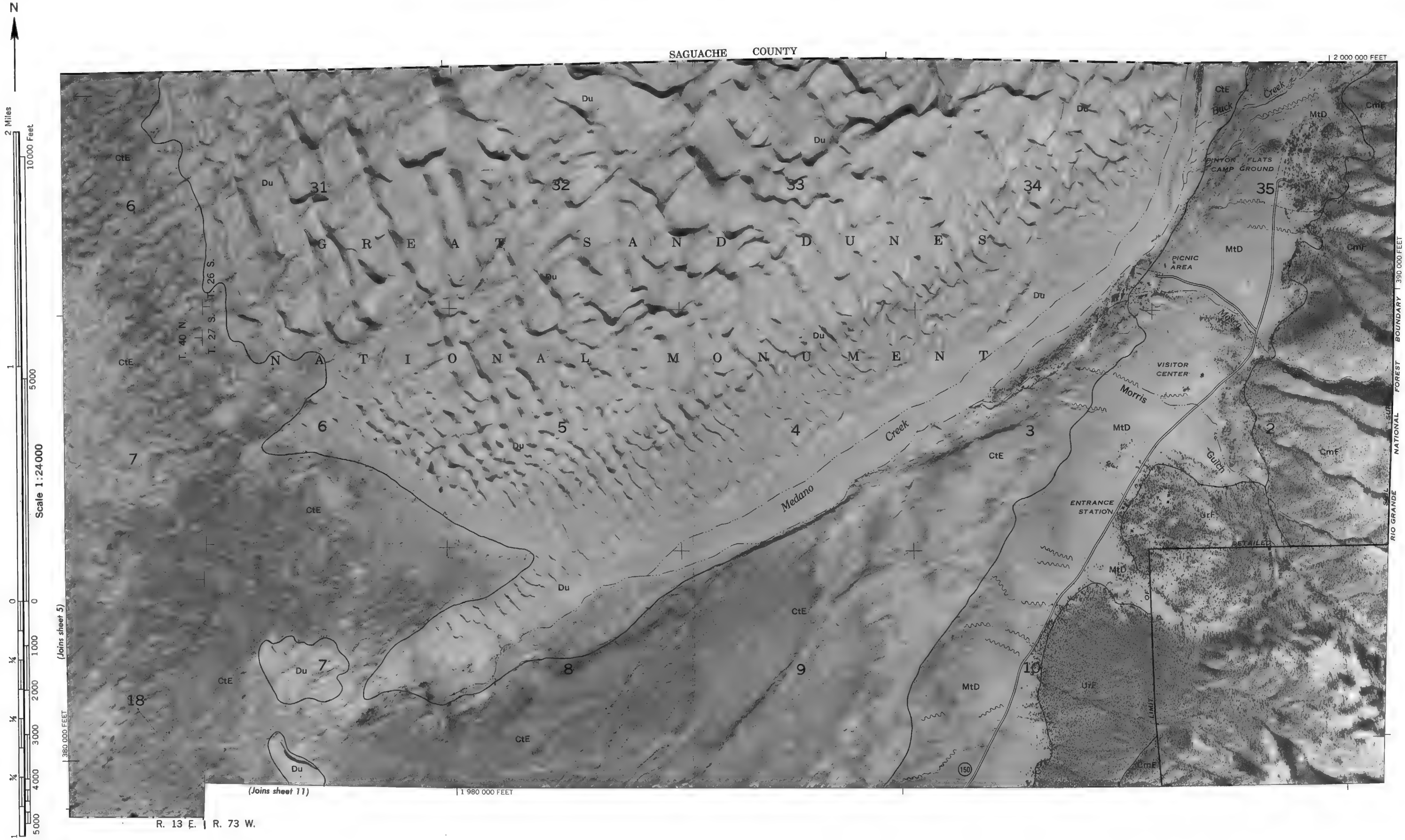
ALAMOSA AREA, COLORADO — SHEET NUMBER 5

5



This map is one of a set compiled in 1971 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, in cooperation with the Colorado Experiment Station.
Photobase from 1969 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the Colorado coordinate system, south zone.
Land division corners are approximately positioned on this map.

ALAMOSA AREA, COLORADO NO. 5

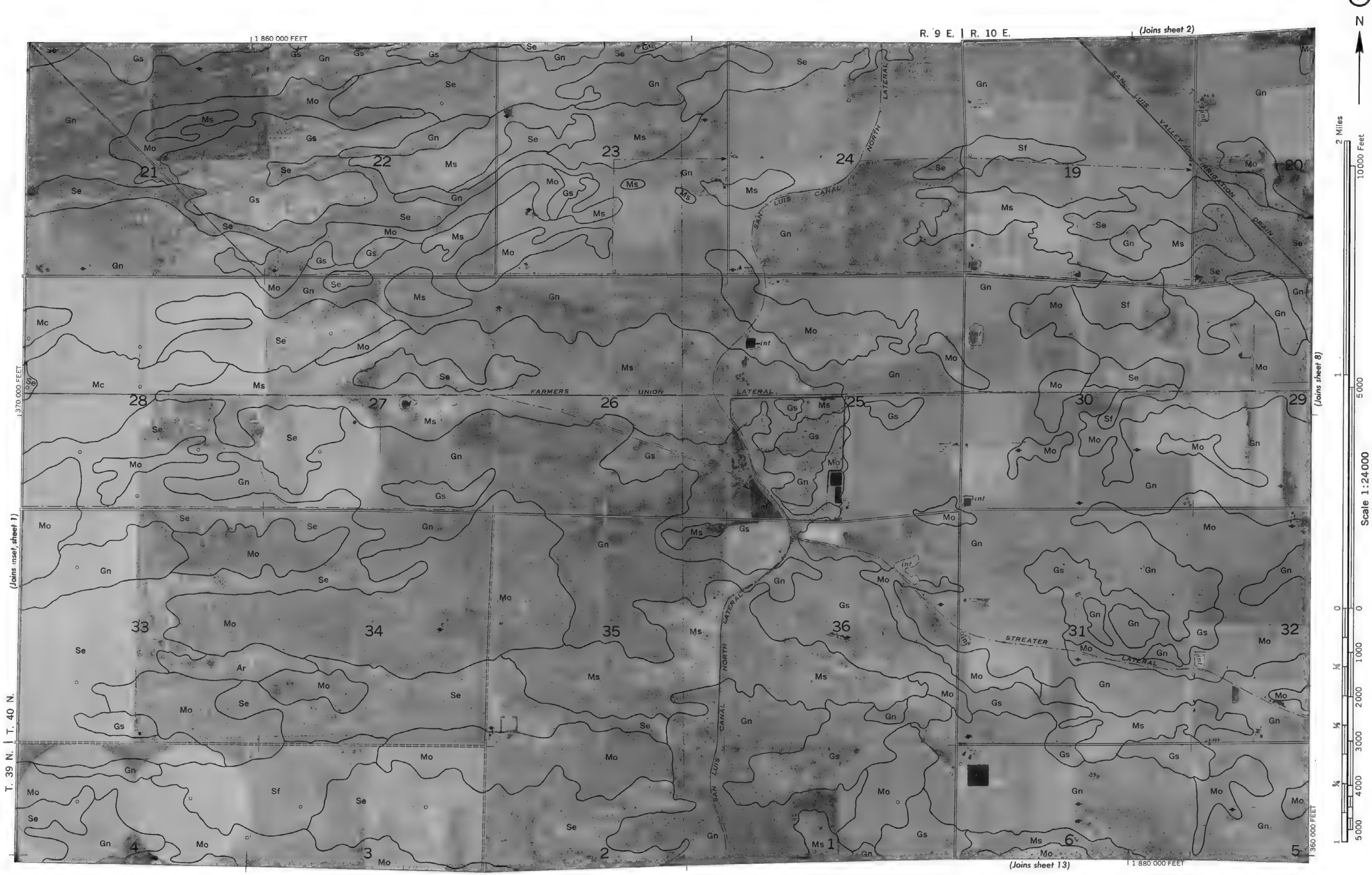


ALAMOSA AREA, COLORADO NO. 6

Land division corners are approximately positioned on this map.

Photobase from 1969 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the Colorado coordinate system, south zone.

This map is one of a set compiled in 1971 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, in cooperation with the Colorado Experiment Station.



This map is one of a set compiled in 1971 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, in cooperation with the Colorado Experiment Station. Photobase from 1969 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the Colorado coordinate system, south zone. Land division corners are approximately positioned on this map.

8

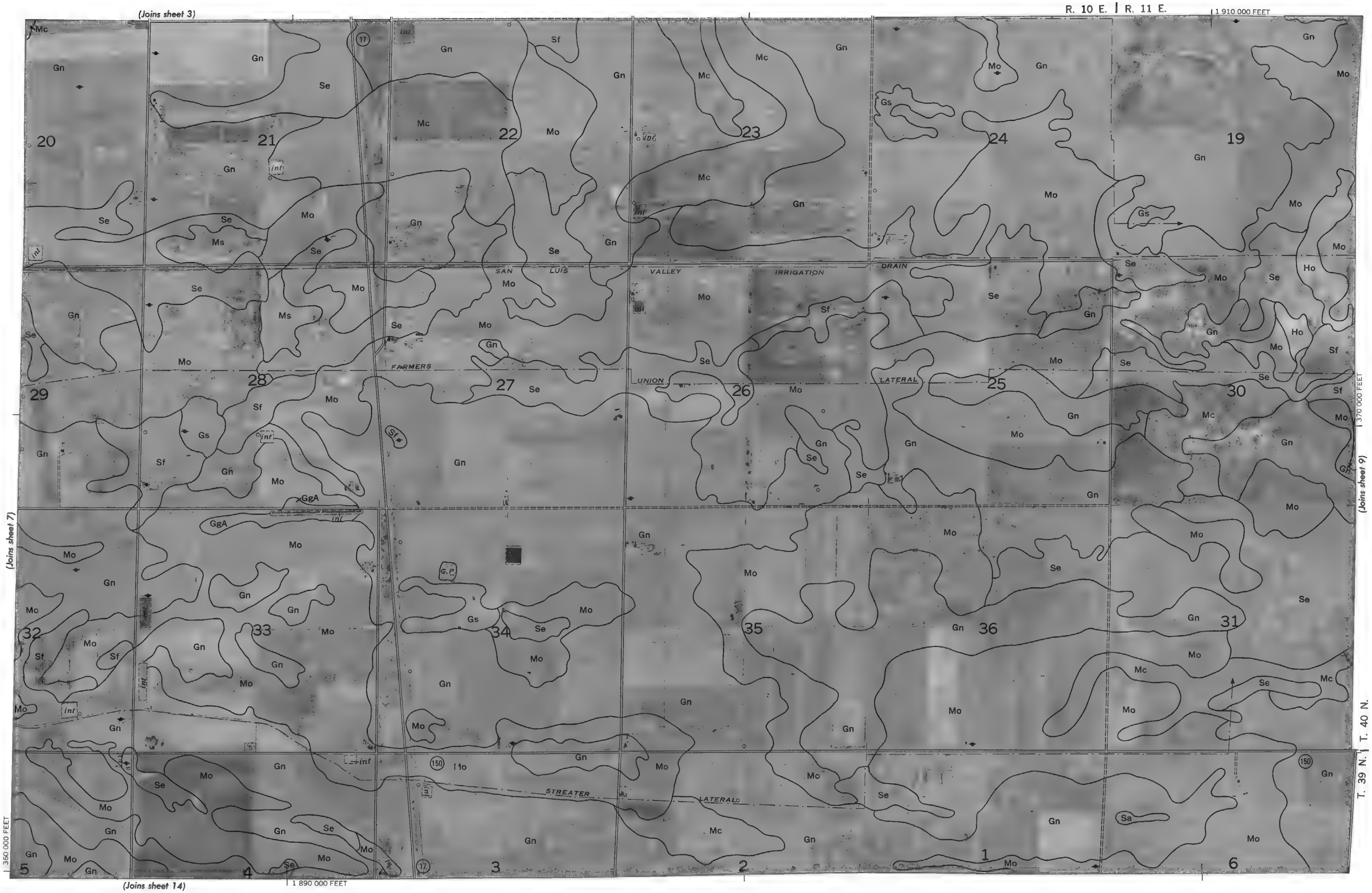
ALAMOSA AREA, COLORADO — SHEET NUMBER 8

N

Scale 1:24000

2 Miles — 1 — 0 — ¼ — ½ — ¾ — 1

10 000 Feet — 5000 — 0 — 1000 — 2000 — 3000 — 4000 — 5000



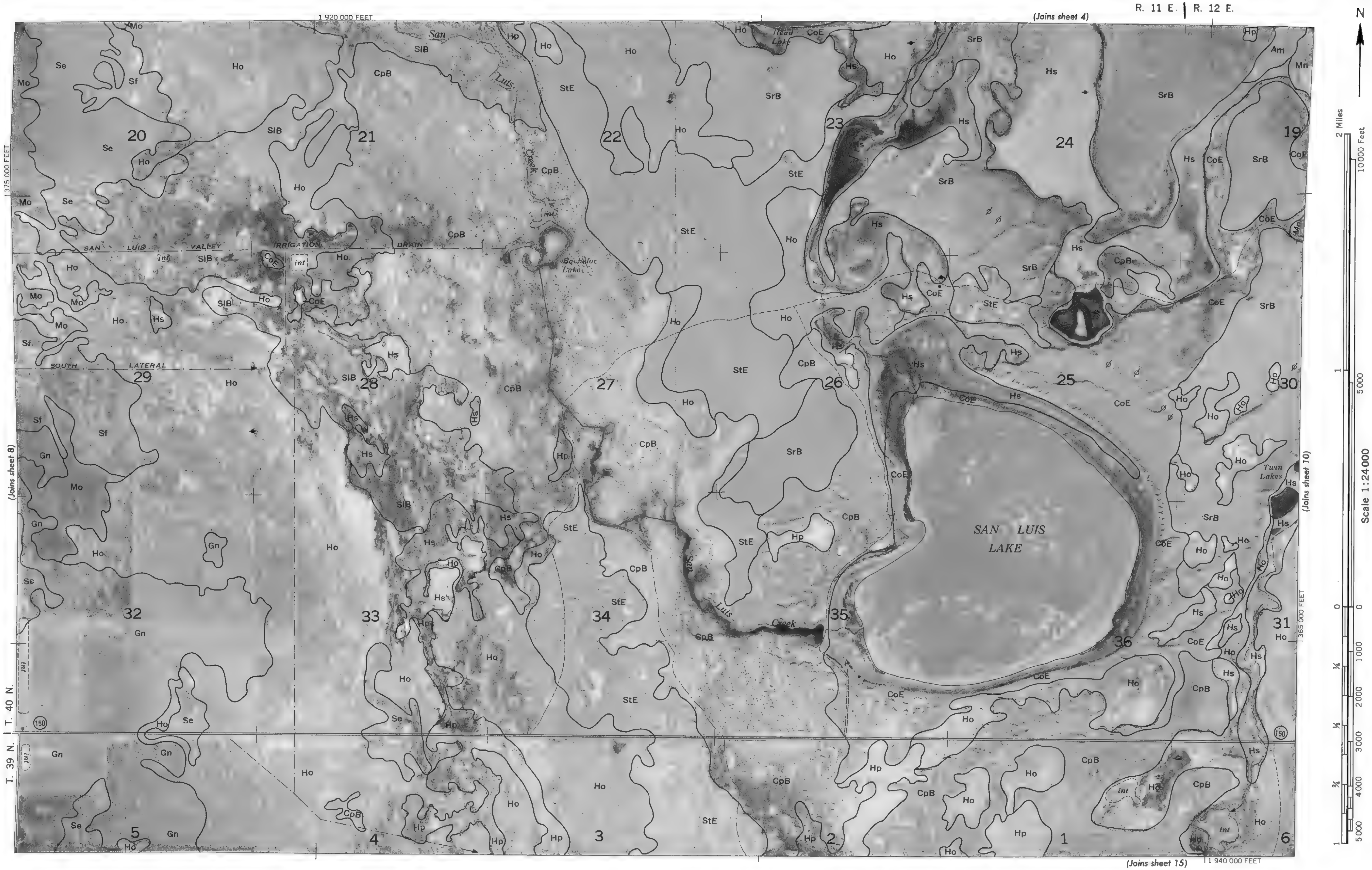
ALAMOSA AREA, COLORADO NO. 8

Land division corners are approximately positioned on this map.

Photobase from 1969 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the Colorado coordinate system, south zone.

This map is one of a set compiled in 1971 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, in cooperation with the Colorado Agricultural Experiment Station.

9



ALAMOSA AREA, COLORADO NO. 9

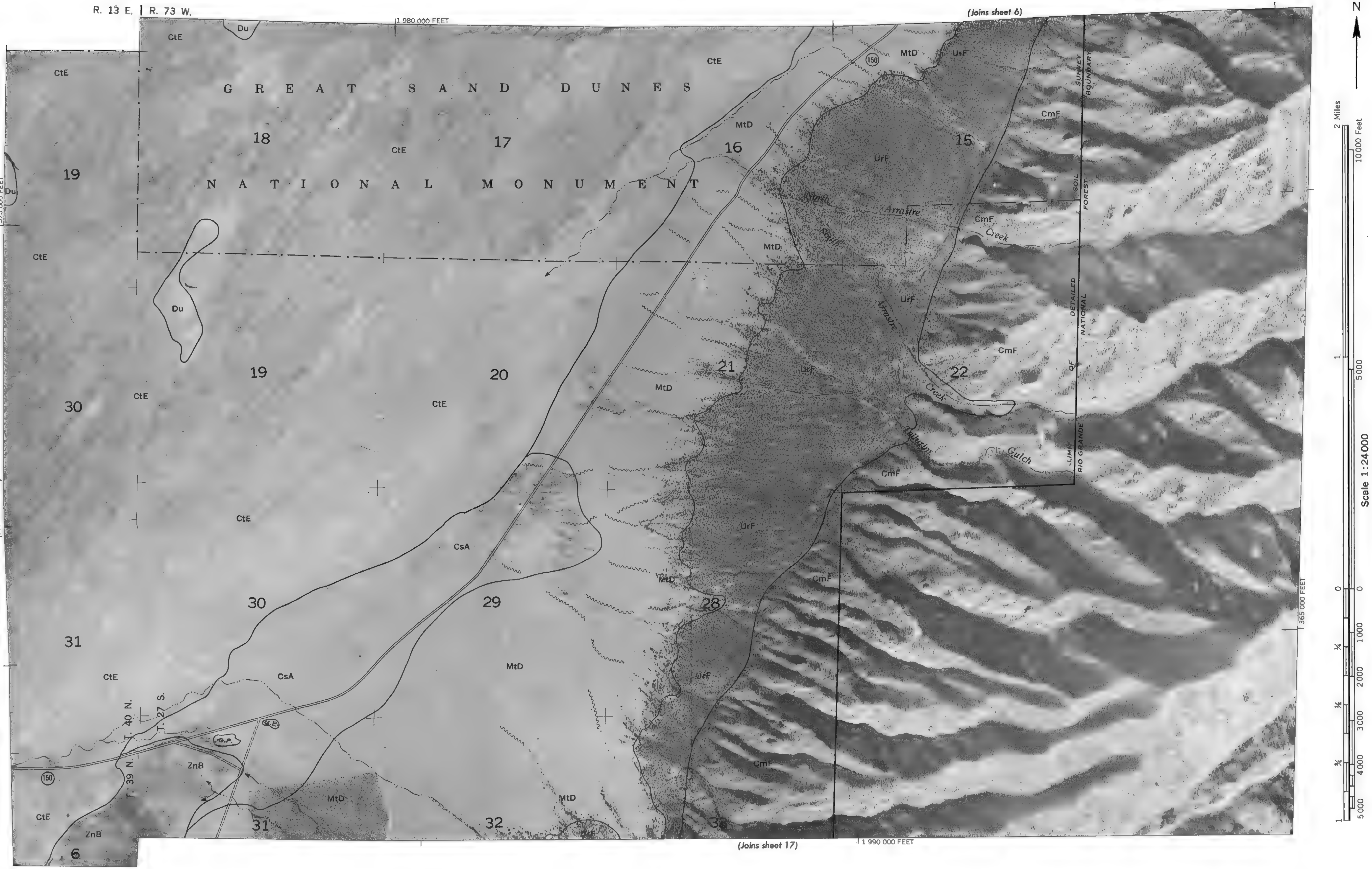
This map is one of a set compiled in 1971 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, in cooperation with the Colorado Experiment Station.
Photobase from 1969 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the Colorado coordinate system, south zone.
Land division corners are approximately positioned on this map.

ALAMOSA AREA, COLORADO NO. 10

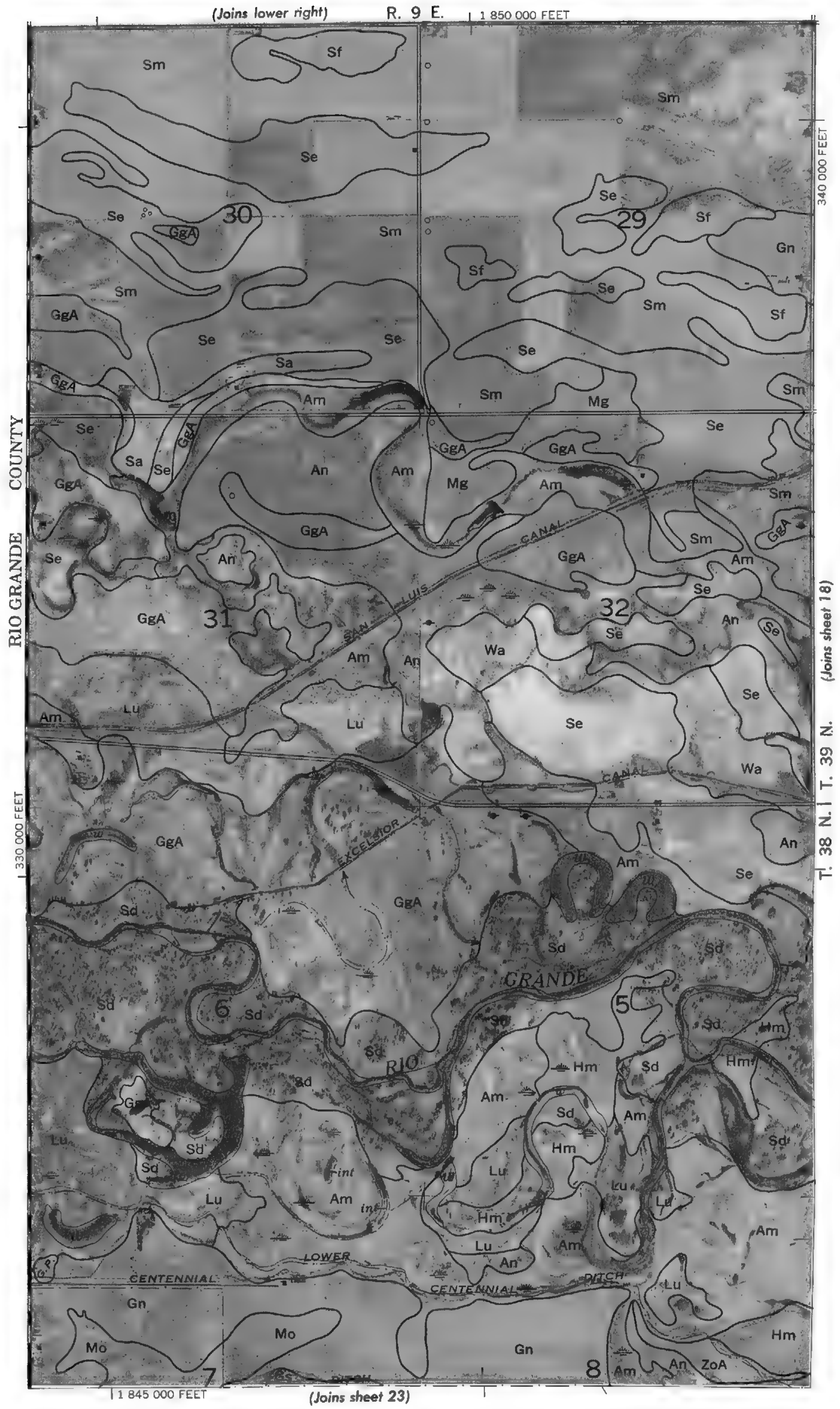
Land division corners are approximately positioned on this map.

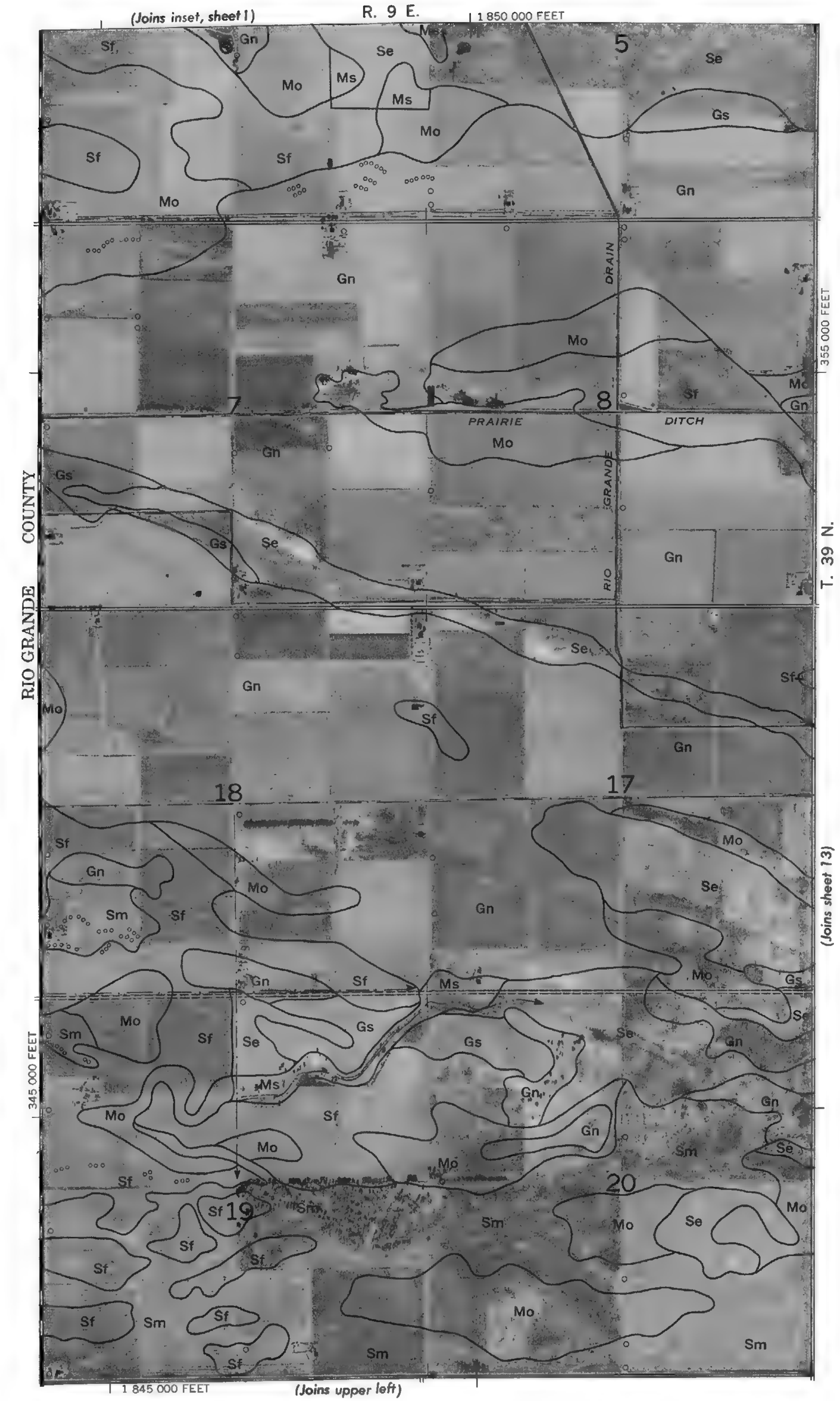
Photobase from 1969 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the Colorado coordinate system, south zone.

This map is one of a set compiled in 1971 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, in cooperation with the Colorado Experiment Station.



This map is one of a set compiled in 1971 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, in cooperation with the Colorado Experiment Station.
Photobase from 1969 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the Colorado coordinate system, south zone.
Land division corners are approximately positioned on this map.





5000 AND 10000-FOOT GRID TICKS

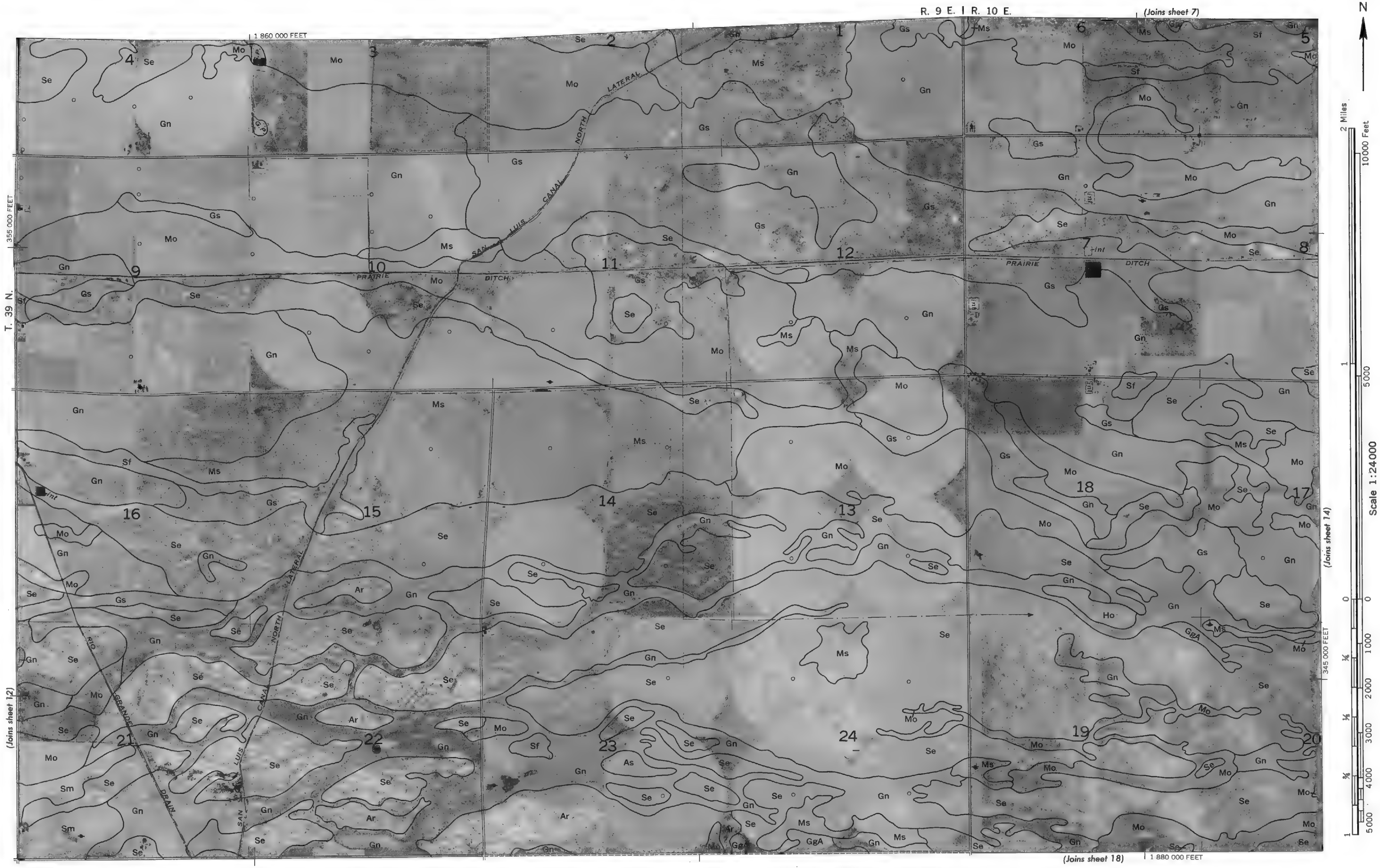
ALAMOSA AREA, COLORADO NO. 12

Land division corners are approximately positioned on this map.

Photobase from 1969 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the Colorado coordinate system, south zone.

This map is one of a set compiled in 1971 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, in cooperation with the Colorado Agricultural Experiment Station.

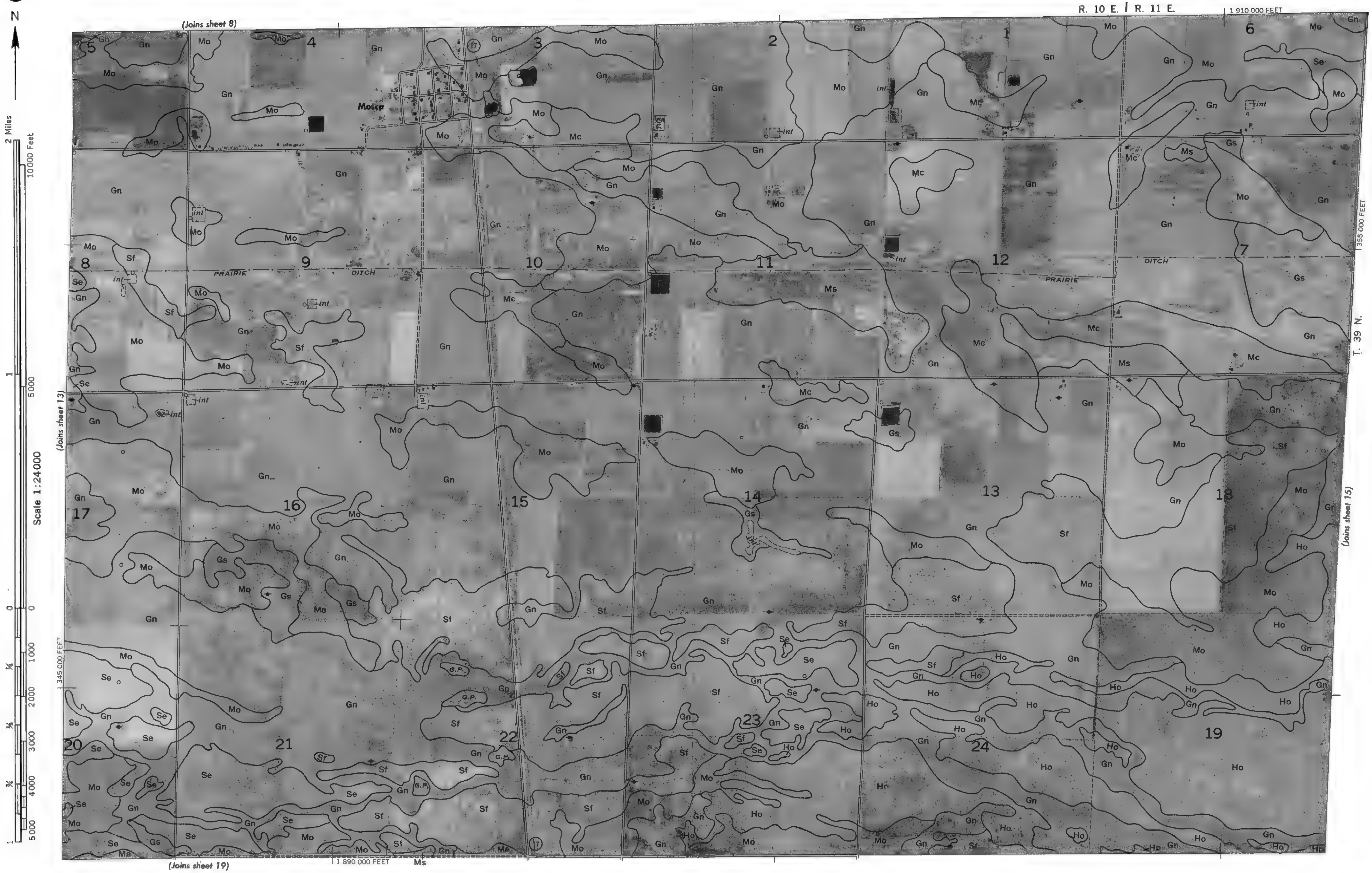
13



This map is one of a set compiled in 1971 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, in cooperation with the Colorado Experiment Station.
Photobase from 1969 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the Colorado coordinate system, south zone.
Land division corners are approximately positioned on this map.

ALAMOSA AREA, COLORADO NO. 13

ALAMOSA AREA, COLORADO — SHEET NUMBER 14

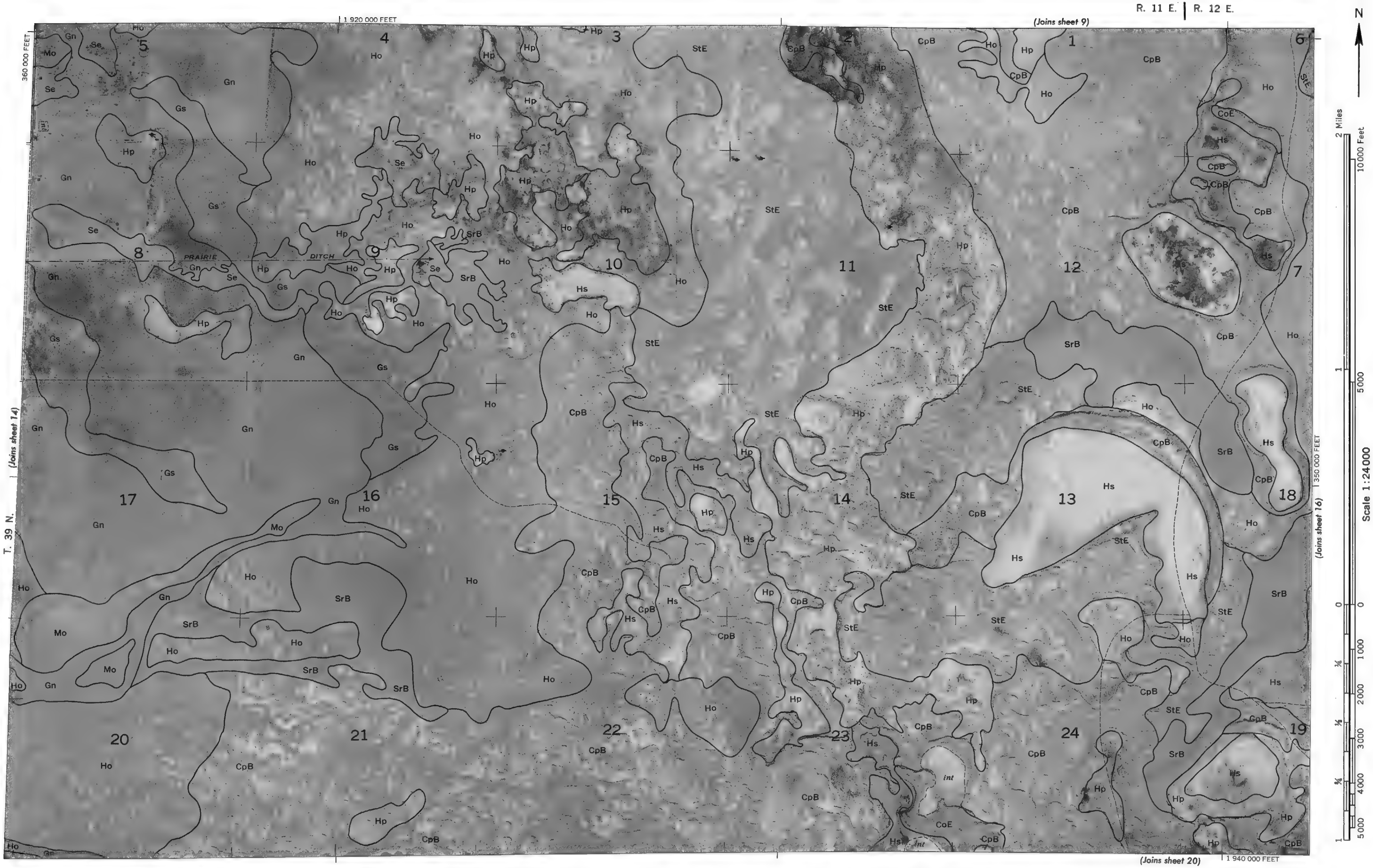


ALAMOSA AREA, COLORADO NO. 14

Land division corners are approximately positioned on this map.

Photobase from 1969 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the Colorado coordinate system, south zone.

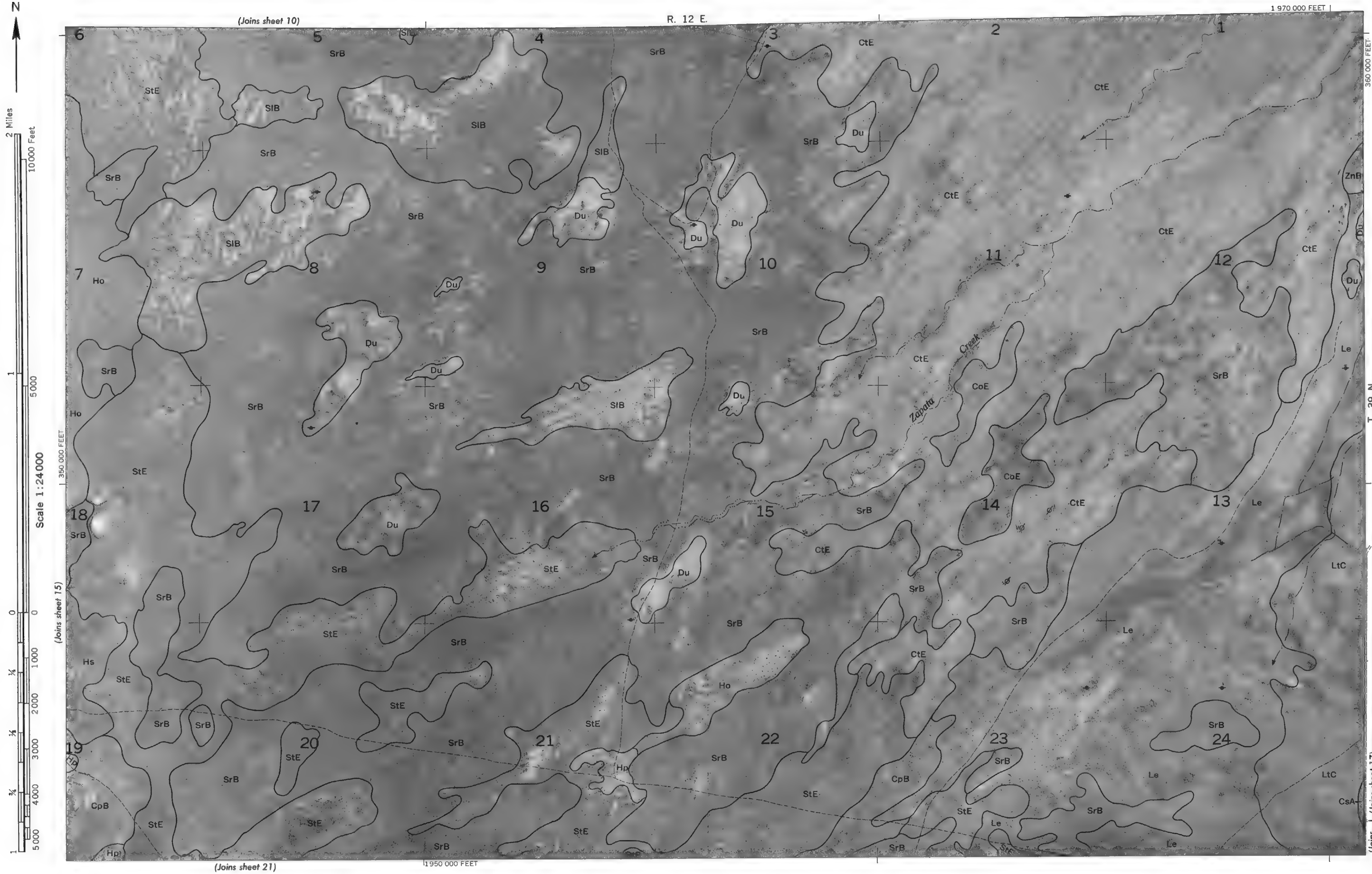
This map is one of a set compiled in 1971 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, in cooperation with the Colorado Experiment Station.



This map is one of a set compiled in 1971 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, in cooperation with the Colorado Experiment Station.
Photobase from 1969 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the Colorado coordinate system, south zone.
Land division corners are approximately positioned on this map.

ALAMOSA AREA, COLORADO NO. 15

ALAMOSA AREA, COLORADO — SHEET NUMBER 16

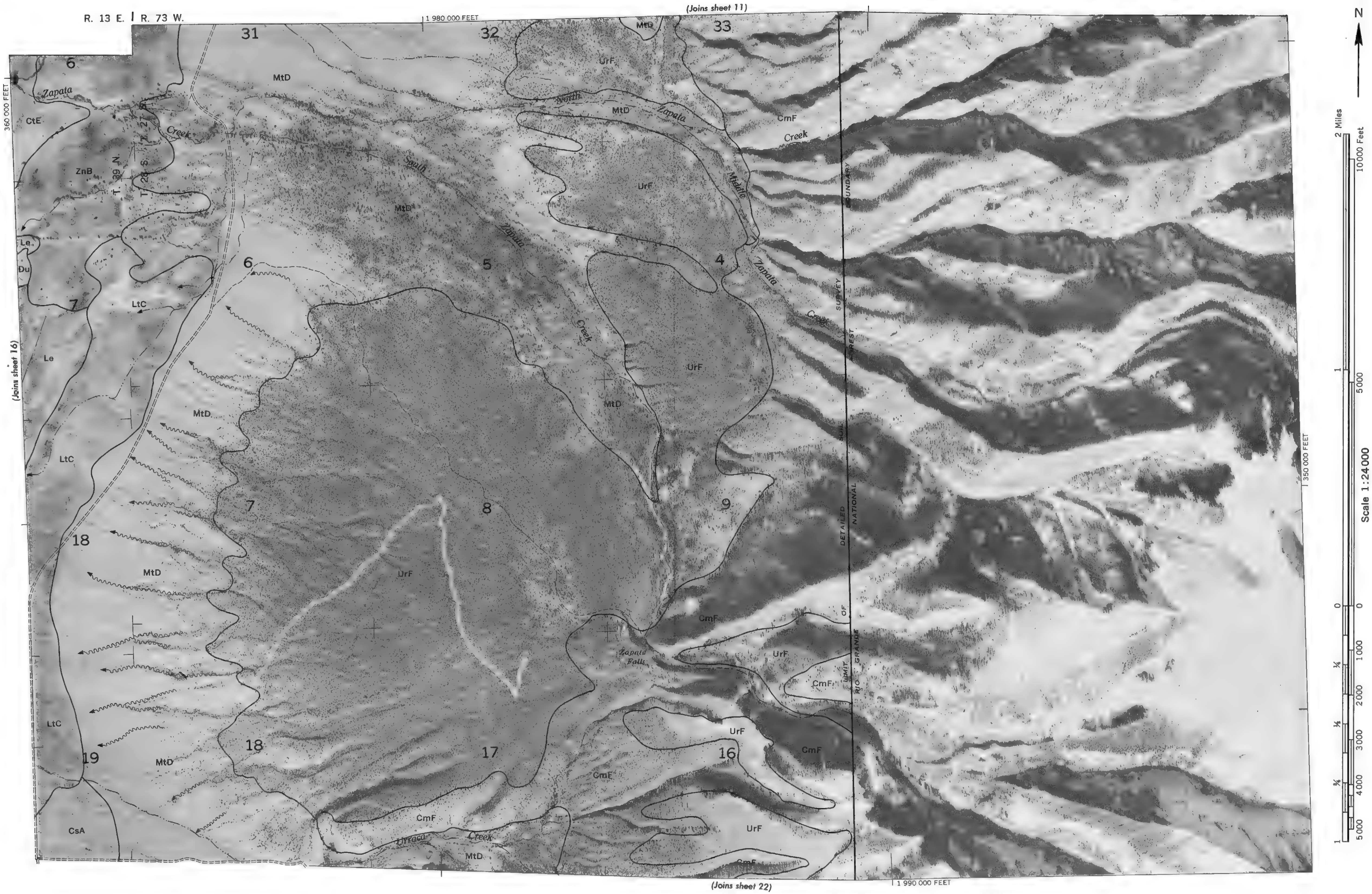


ALAMOSA AREA, COLORADO NO. 16

Land division corners are approximately positioned on this map.

Photobase from 1969 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the Colorado coordinate system, south zone.

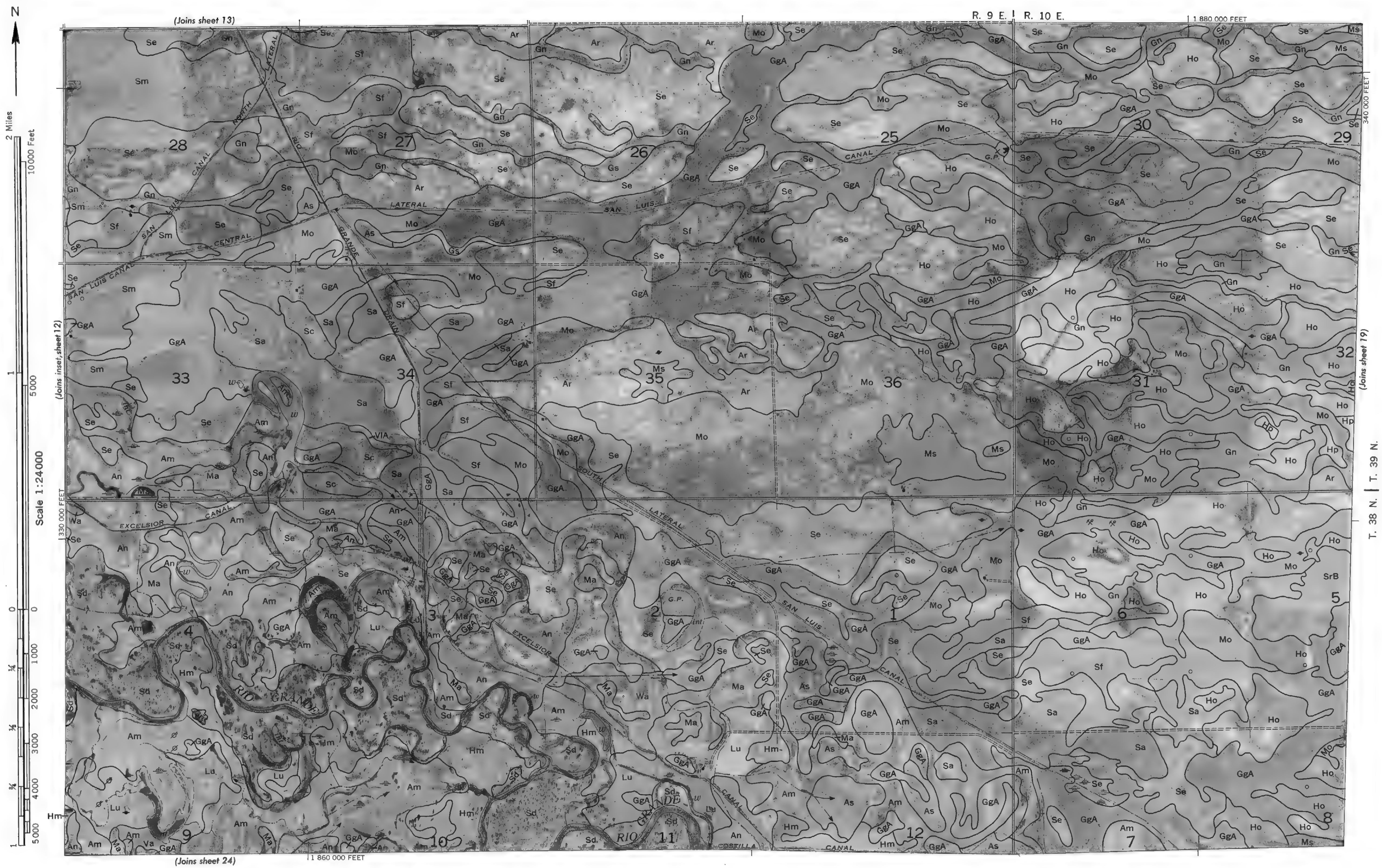
This map is one of a set compiled in 1971 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, in cooperation with the Colorado Agricultural Experiment Station.



This map is one of a set compiled in 1971 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, in cooperation with the Colorado Experiment Station.
Photobase from 1969 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the Colorado coordinate system, south zone.
Land division corners are approximately positioned on this map.

ALAMOSA AREA, COLORADO NO. 17

ALAMOSA AREA, COLORADO — SHEET NUMBER 18



ALAMOSA AREA, COLORADO NO. 18

Land division corners are approximately positioned on this map.

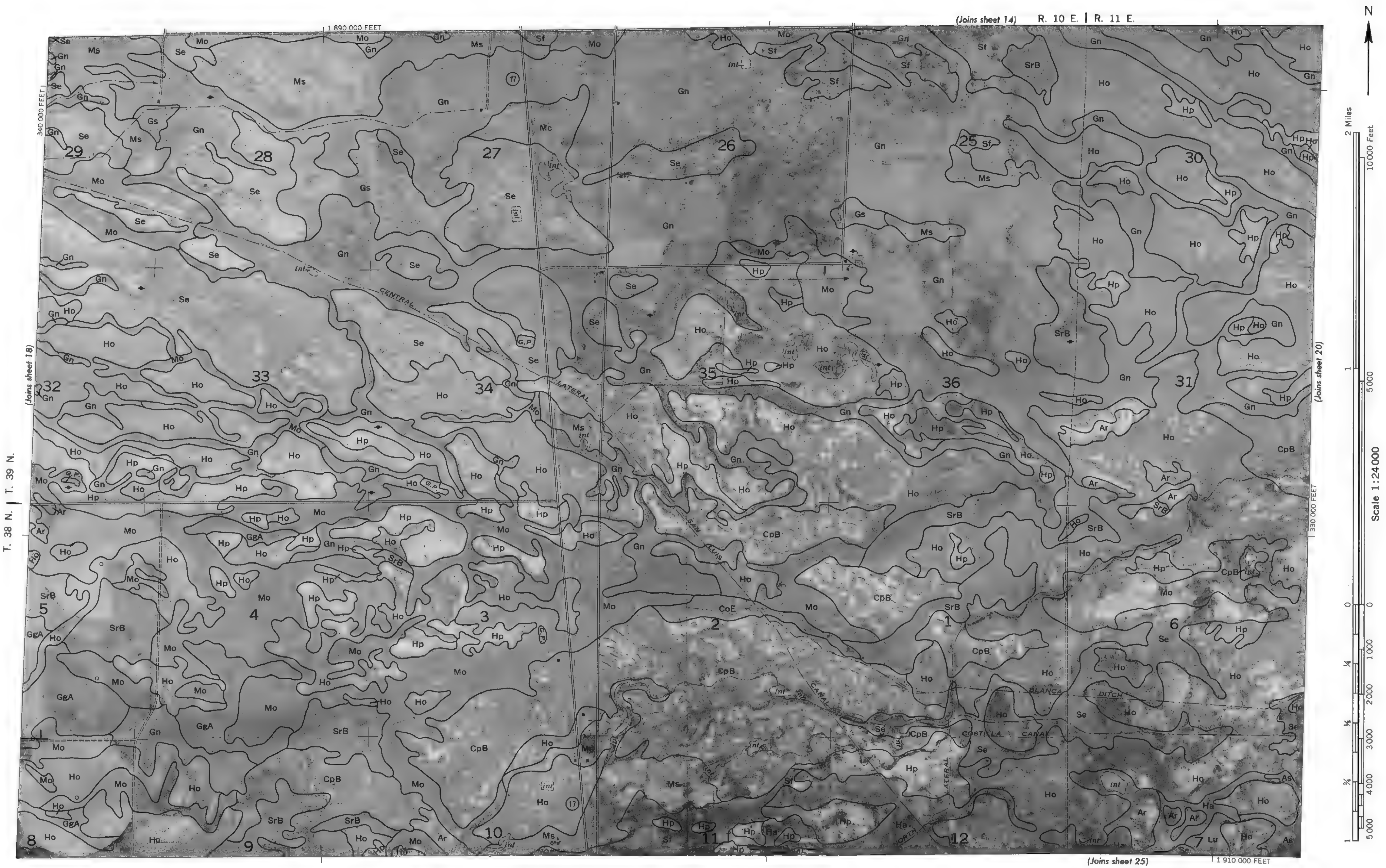
Photobase from 1969 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the Colorado coordinate system, south zone.

This map is one of a set compiled in 1971 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, in cooperation with the Colorado Agricultural Experiment Station.

19

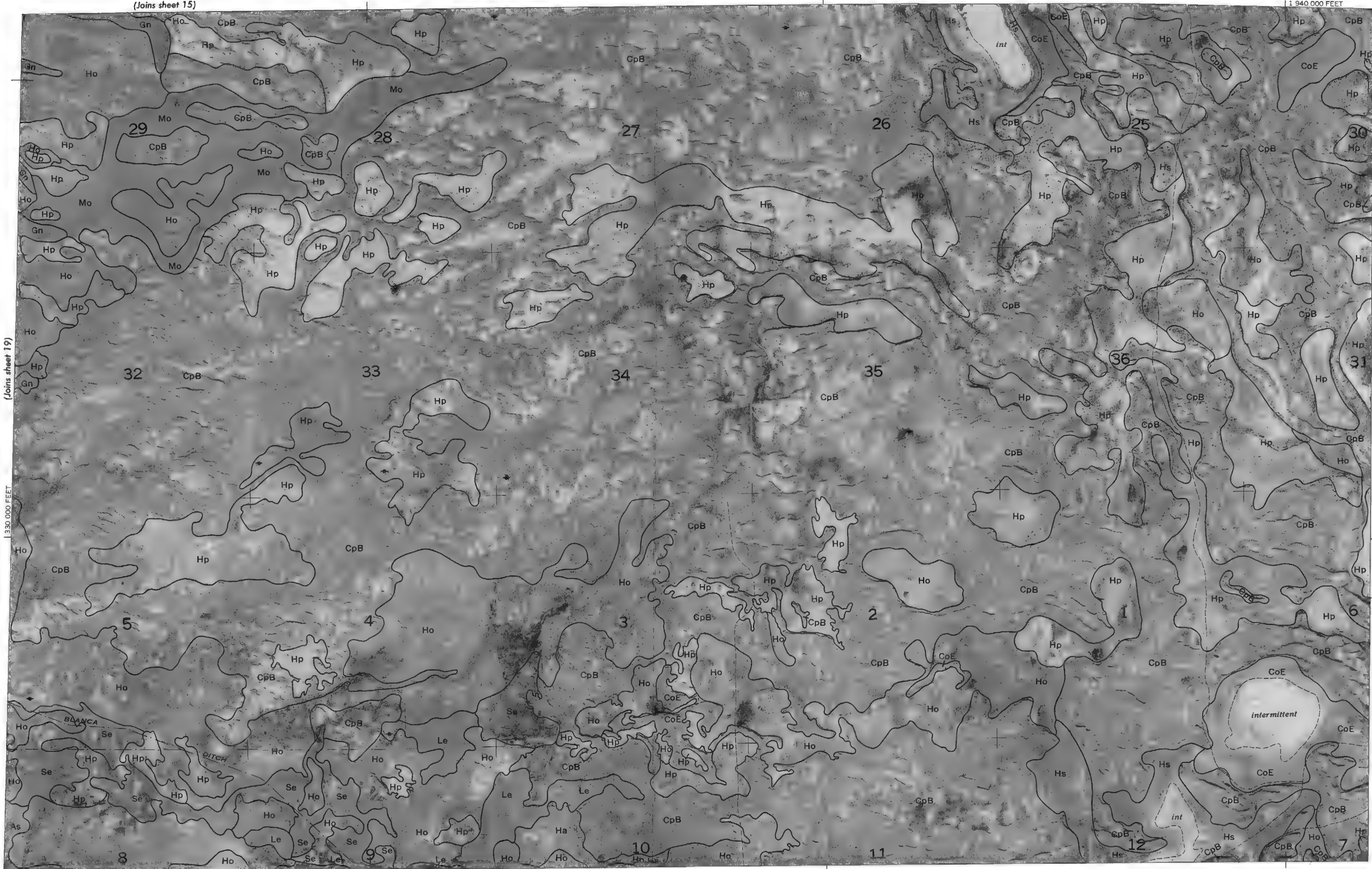
This map is one of a set compiled in 1971 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, in cooperation with the Colorado Agricultural Experiment Station.
Photobase from 1969 aerial photography. Positions 10,000-foot grid ticks are approximate and based on the Colorado coordinate system, south zone.
Land division corners are approximately positioned on this map.

ALAMOSA AREA, COLORADO NO. 19



N

R. 11 E. | R. 12 E.



T. 39 N. | T. 38 N.

Scale 1:24000

2 Miles | 1 | 0 | ¼ | ½ | ¾ | 1

10000 Feet | 5000 | 0 | 1000 | 2000 | 3000 | 4000 | 5000

Land division corners are approximately positioned on this map.

Photobase from 1969 aerial photography. Position of 10,000-foot grid ticks are approximate and based on the Colorado coordinate system, south zone.

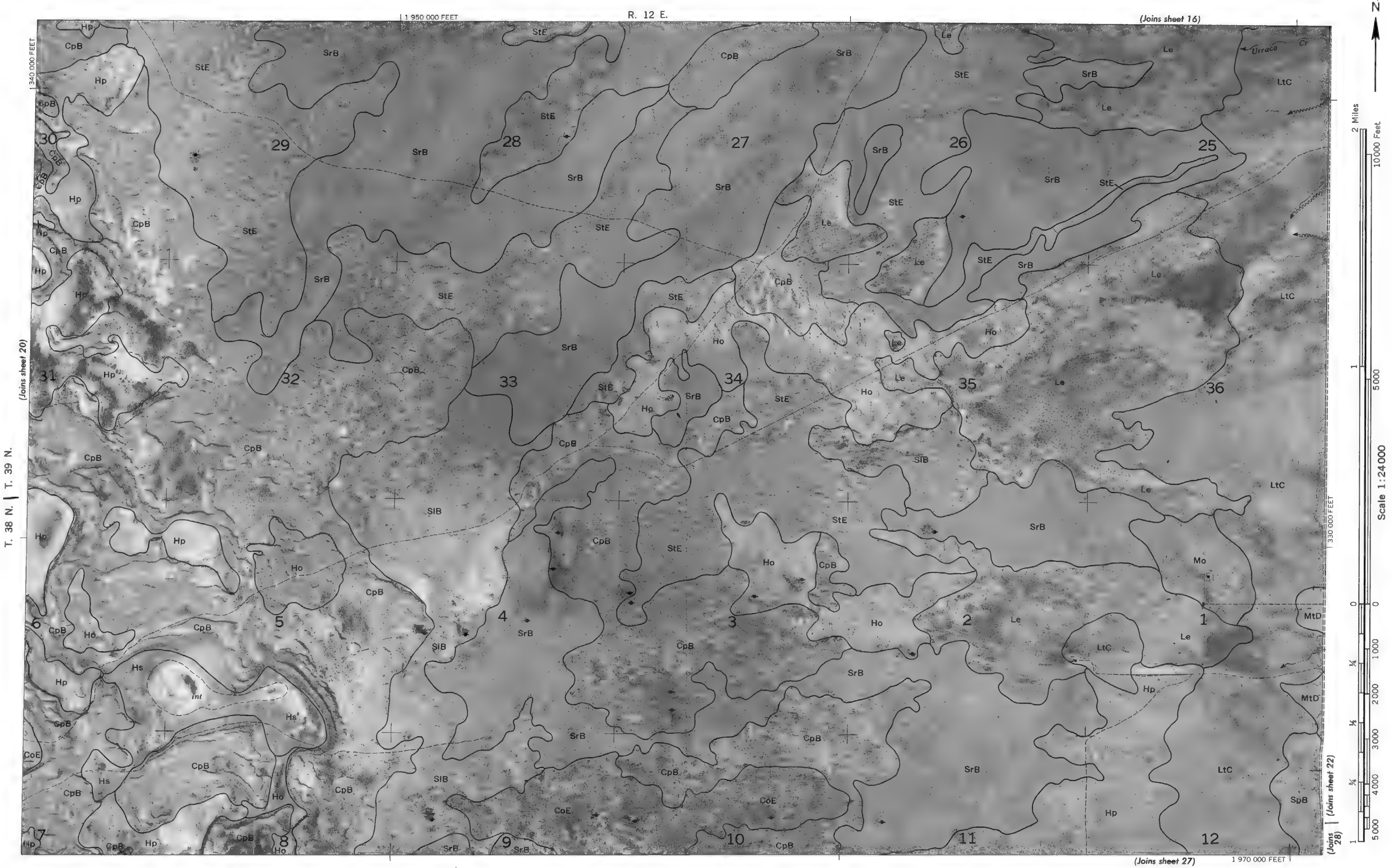
This map is one of a set compiled in 1971 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, in cooperation with the Colorado Agricultural Experiment Station.

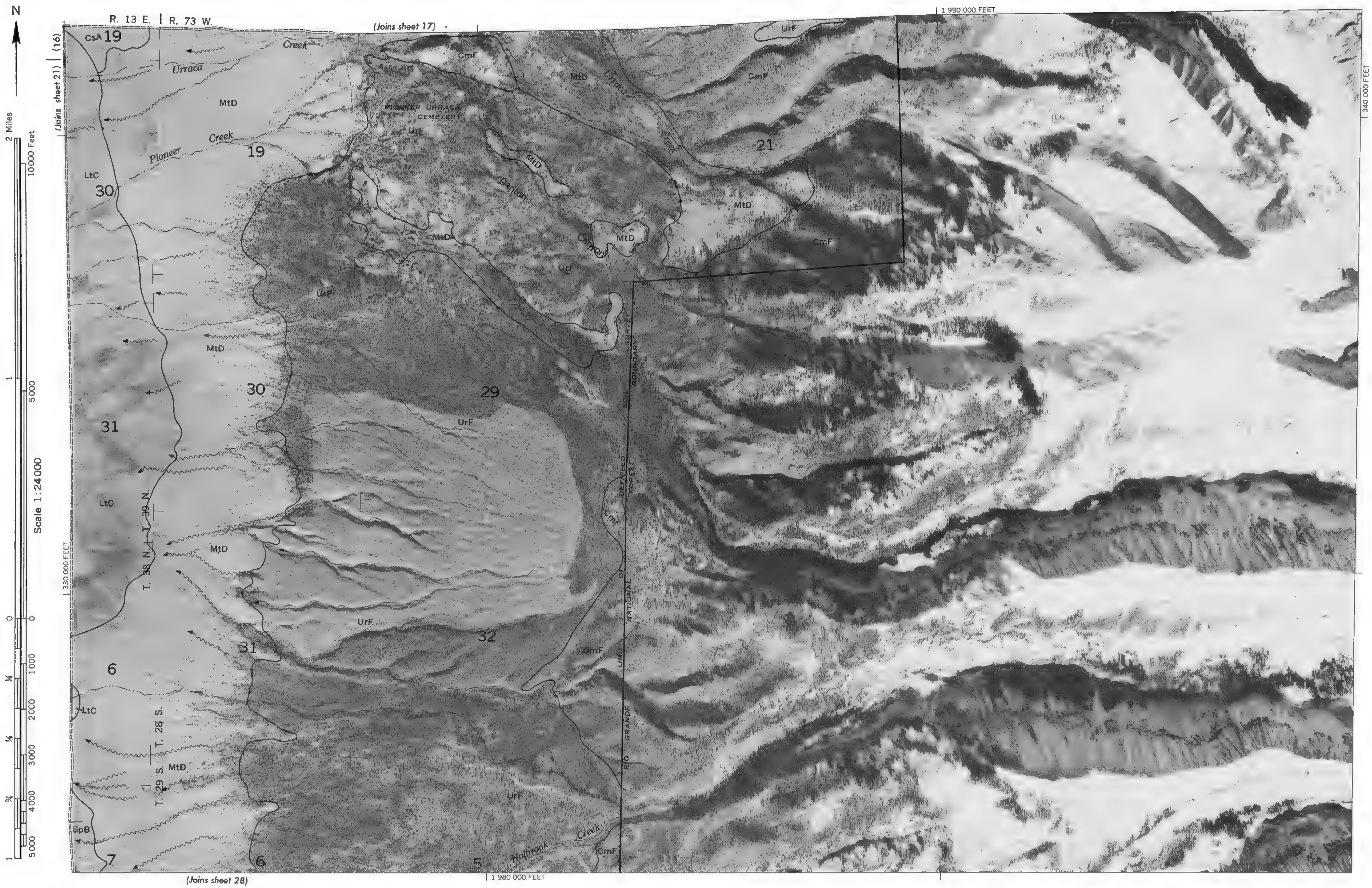
21

This map is one of a set compiled in 1971 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, in cooperation with the Colorado Experiment Station.
Photobase from 1969 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the Colorado coordinate system, south zone.
Land division corners are approximately positioned on this map.

ALAMOSA AREA, COLORADO NO. 21

T. 38 N. | T. 39 N.





ALAMOSA AREA, COLORADO NO. 22

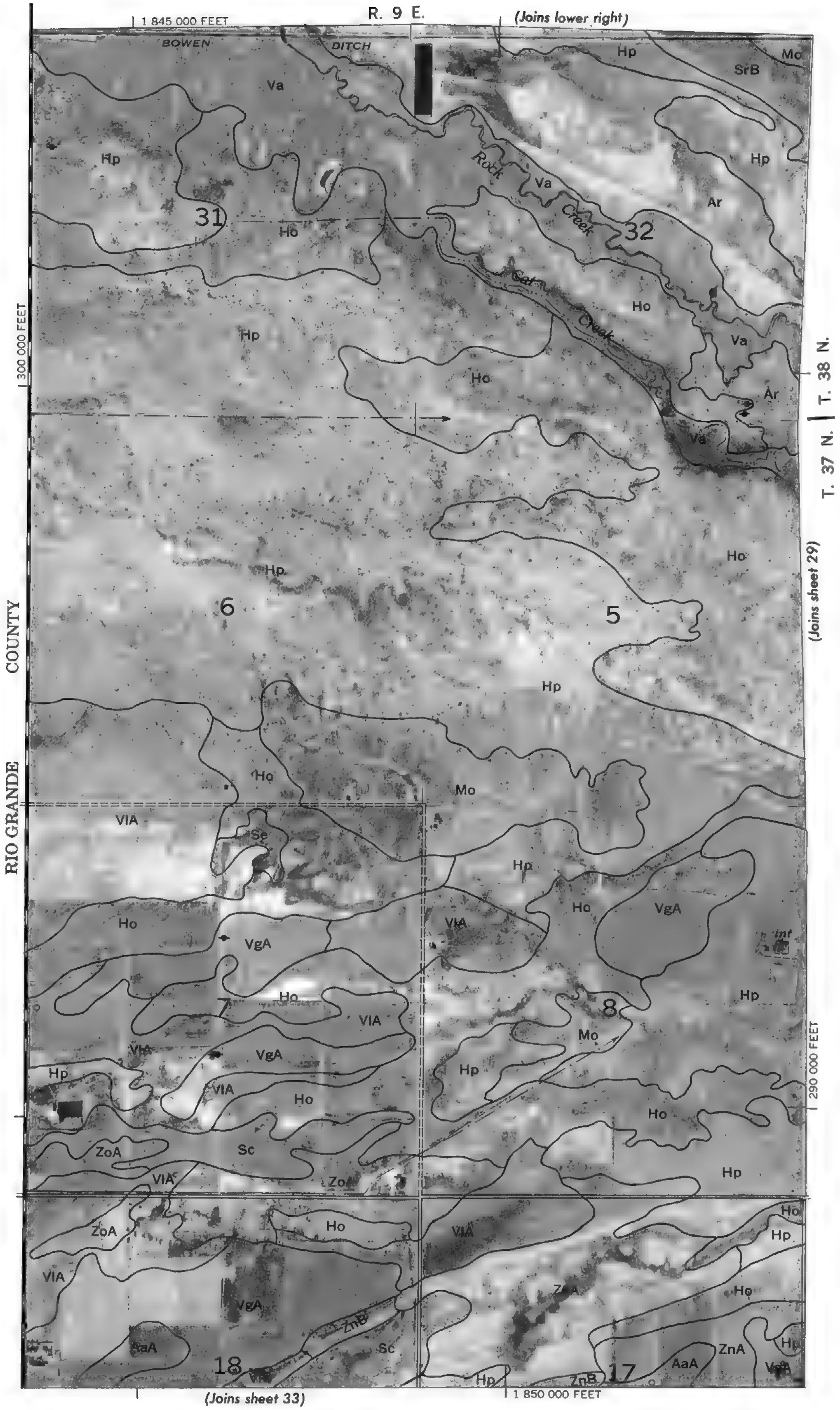
Land division corners are approximately positioned on this map.

Photobase from 1969 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the Colorado coordinate system, south zone.

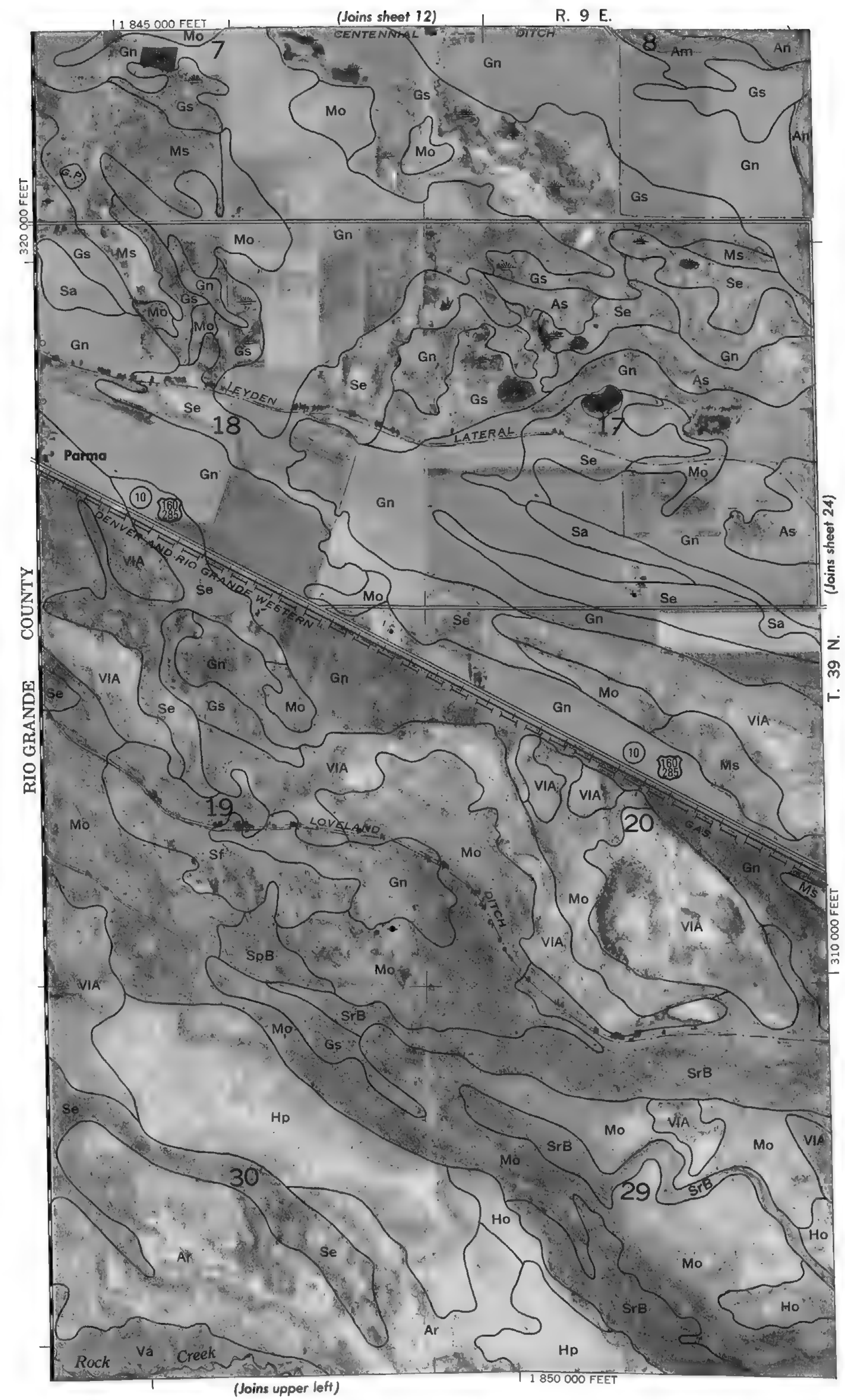
This map is one of a set compiled in 1971 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, in cooperation with the Colorado Experiment Station.

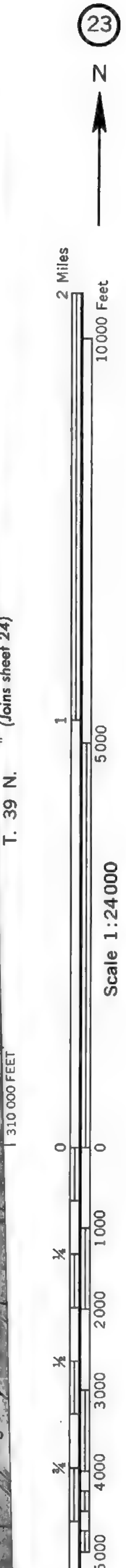
This map is one of a set compiled in 1971 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, in cooperation with the Colorado Experiment Station.
Photobase from 1969 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the Colorado coordinate system, south zone.
Land division corners are approximately positioned on this map.

ALAMOSA AREA, COLORADO NO. 23

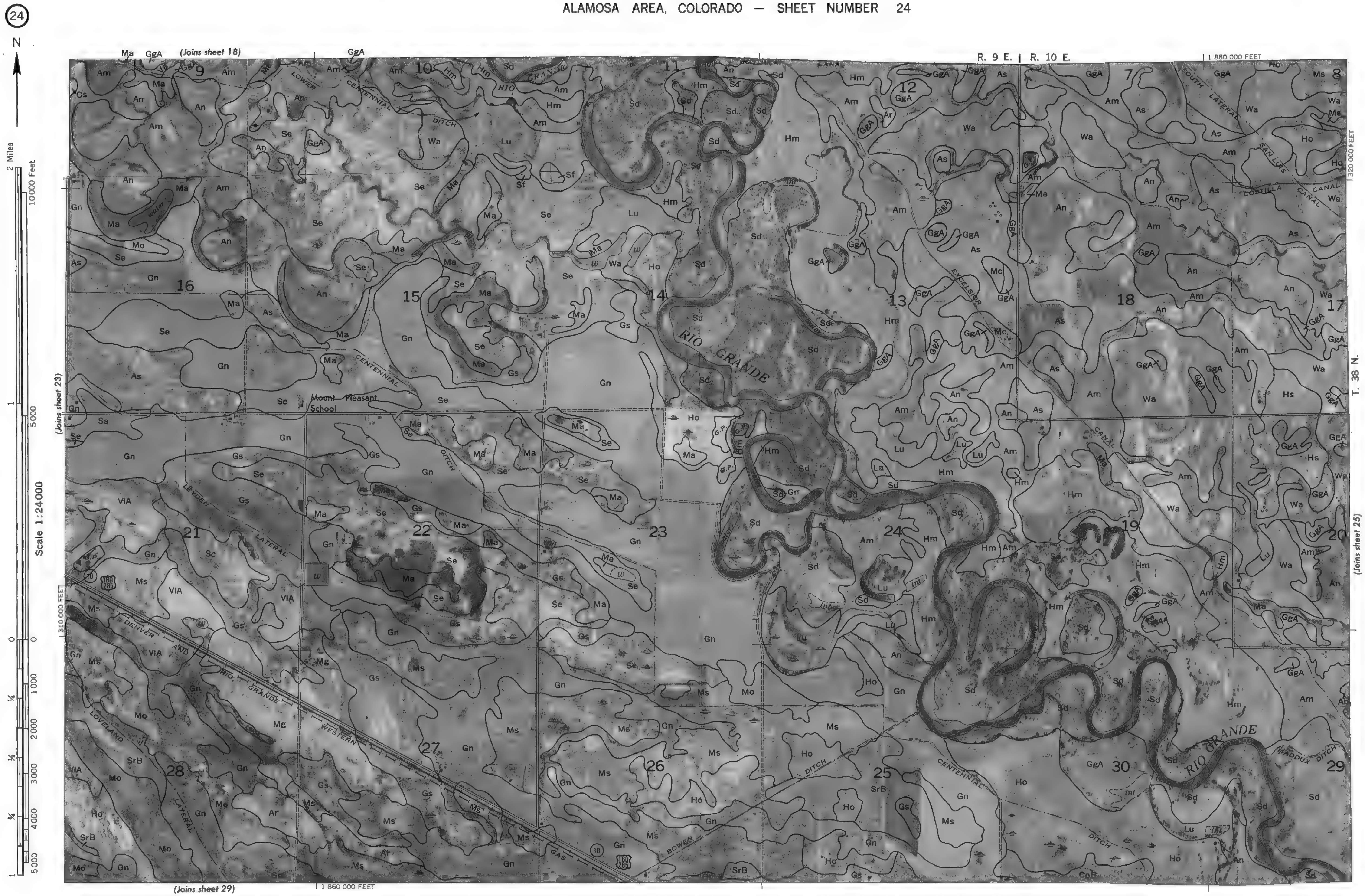


5000 AND 10000-FOOT GRID TICKS





5000 AND 10000-FOOT GRID TICKS



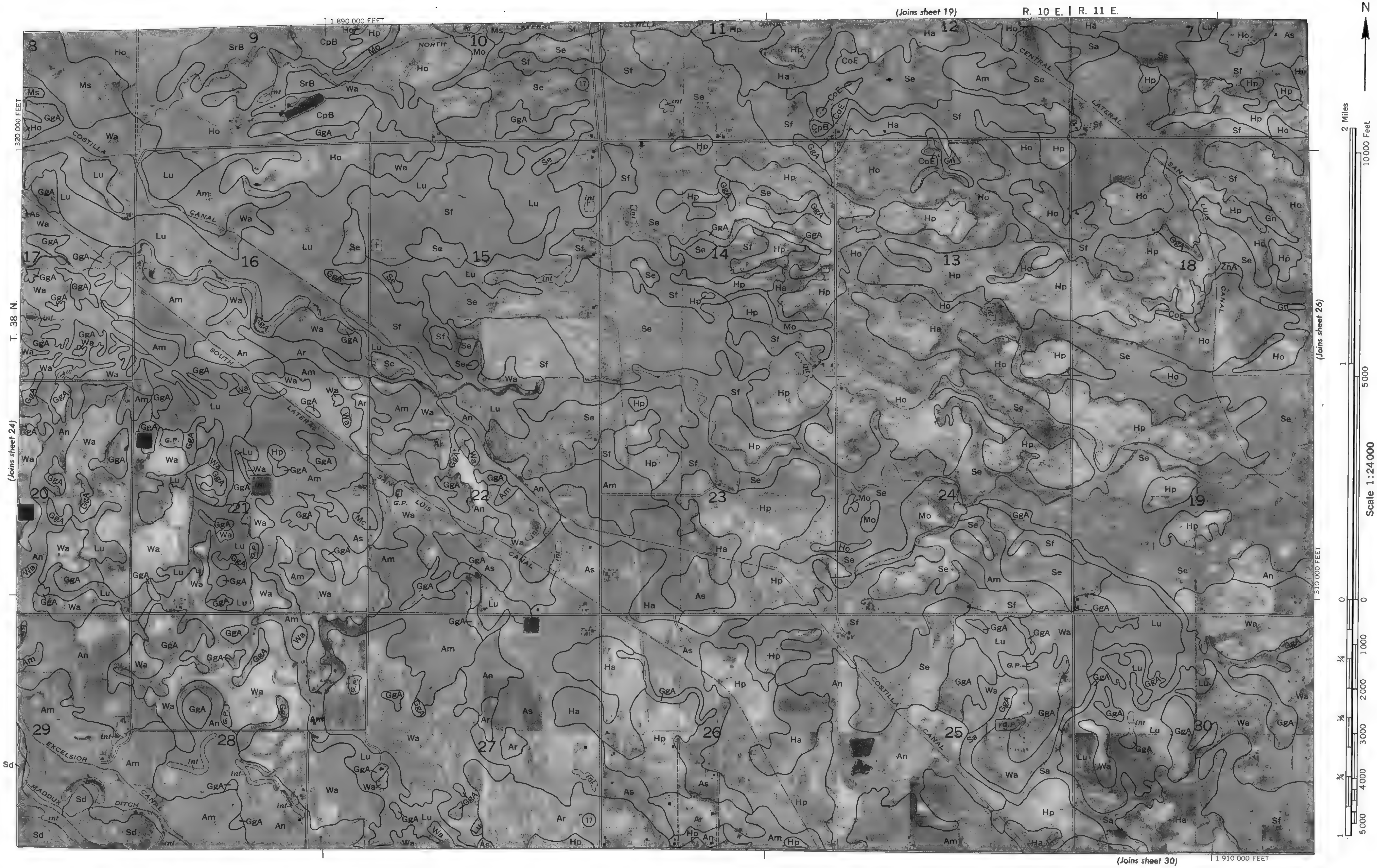
ALAMOSA AREA, COLORADO NO. 24

Land division corners are approximately positioned on this map.

Photobase from 1969 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the Colorado coordinate system, south zone.

This map is one of a set compiled in 1971 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, in cooperation with the Colorado Agricultural Experiment Station.

25



This map is one of a set compiled in 1971 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, in cooperation with the Colorado Experiment Station.
Photobase from 1969 aerial photography. Positions of 10 000-foot grid ticks are approximate and based on the Colorado coordinate system, south zone.
Land division corners are approximately positioned on this map.

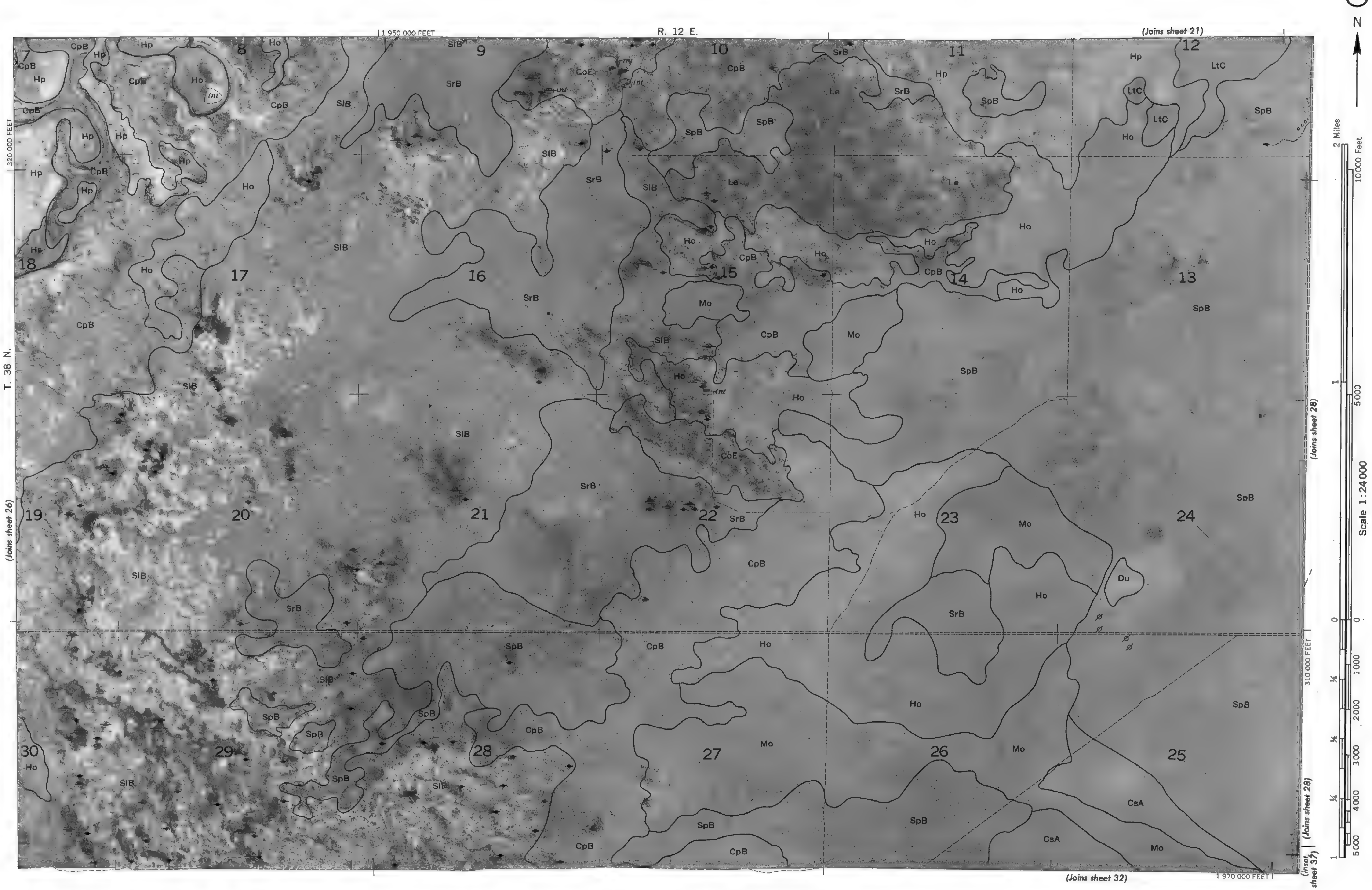
ALAMOSA AREA, COLORADO NO. 25

ALAMOSA AREA, COLORADO NO. 26

Land division corners are approximately positioned on this map.

Photobase from 1969 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the Colorado coordinate system, south zone.

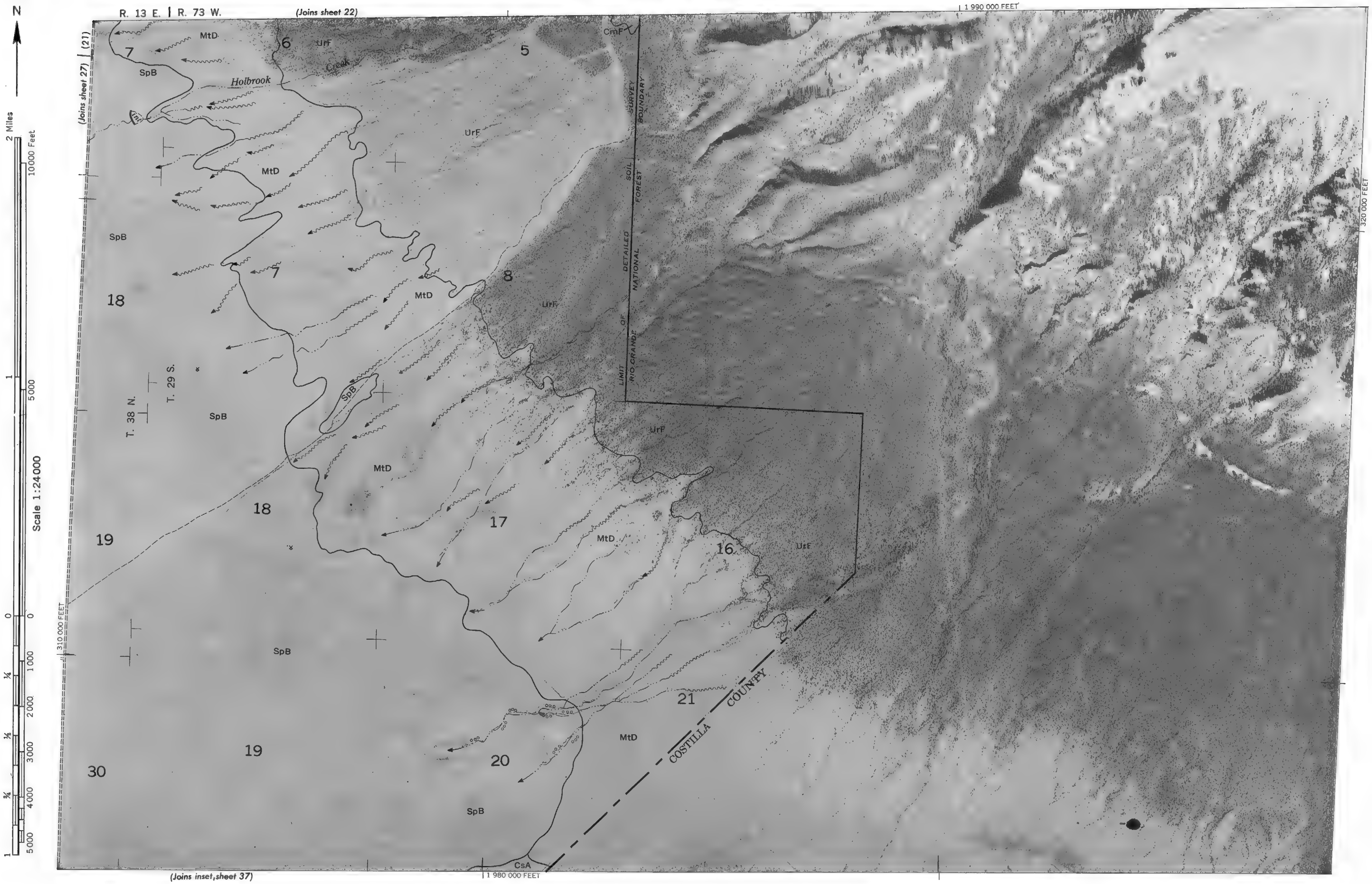
This map is one of a set compiled in 1971 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, in cooperation with the Colorado Agricultural Experiment Station.



This map is one of a set compiled in 1971 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, in cooperation with the Colorado Experiment Station.
Photobase from 1969 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the Colorado coordinate system, south zone.
Land division corners are approximately positioned on this map.

ALAMOSA AREA, COLORADO NO. 27

ALAMOSA AREA, COLORADO — SHEET NUMBER 28



ALAMOSA AREA, COLORADO NO. 28

Land division corners are approximately positioned on this map.

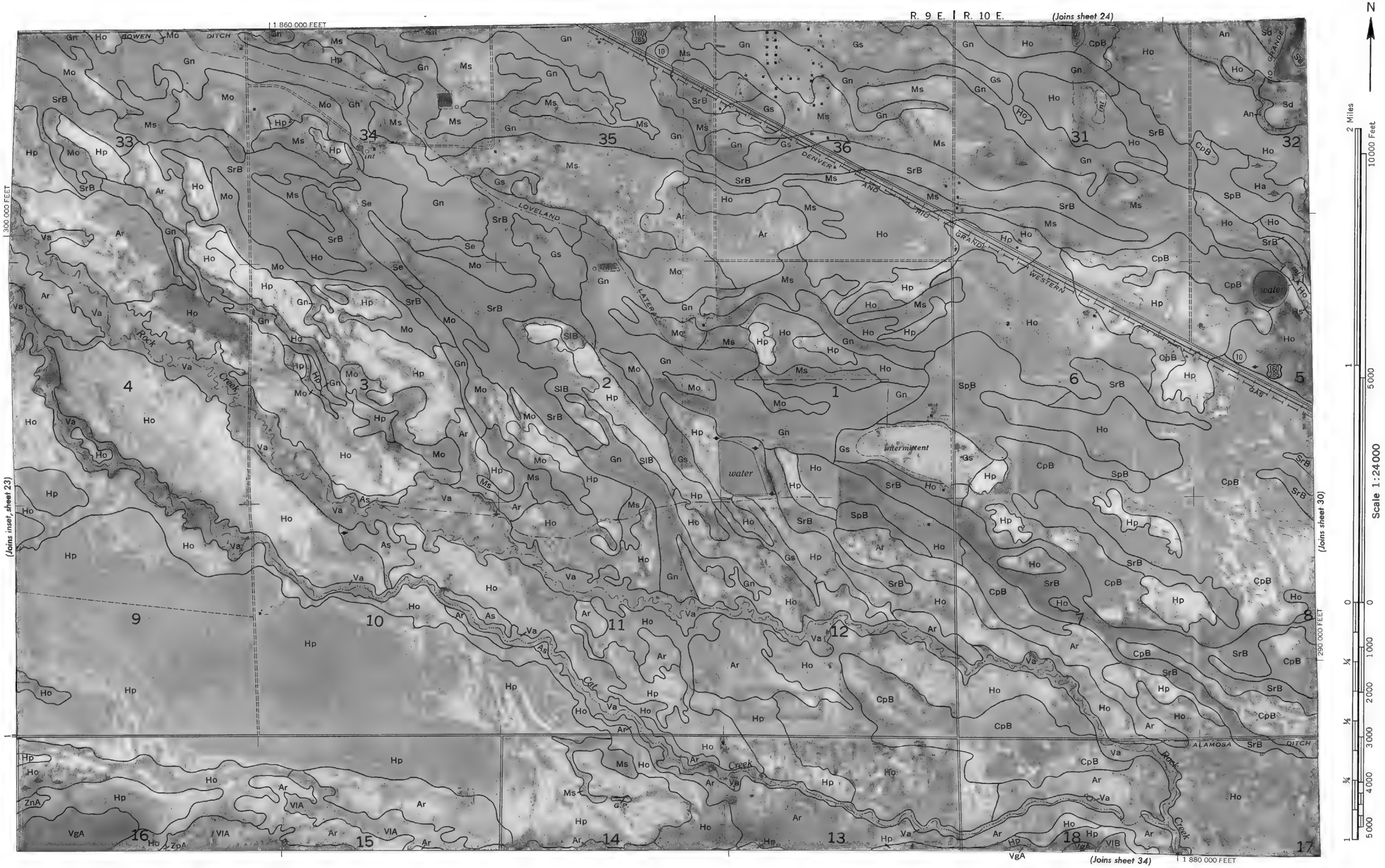
Photobase from 1969 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the Colorado coordinate system, south zone.

This map is one of a set compiled in 1971 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, in cooperation with the Colorado Experiment Station.

29

This map is one of a set compiled in 1971 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, in cooperation with the Colorado Experiment Station.
Photobase from 1969 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the Colorado coordinate system, south zone.
Land division corners are approximately positioned on this map.

ALAMOSA AREA, COLORADO NO. 29



ALAMOSA AREA, COLORADO NO. 30

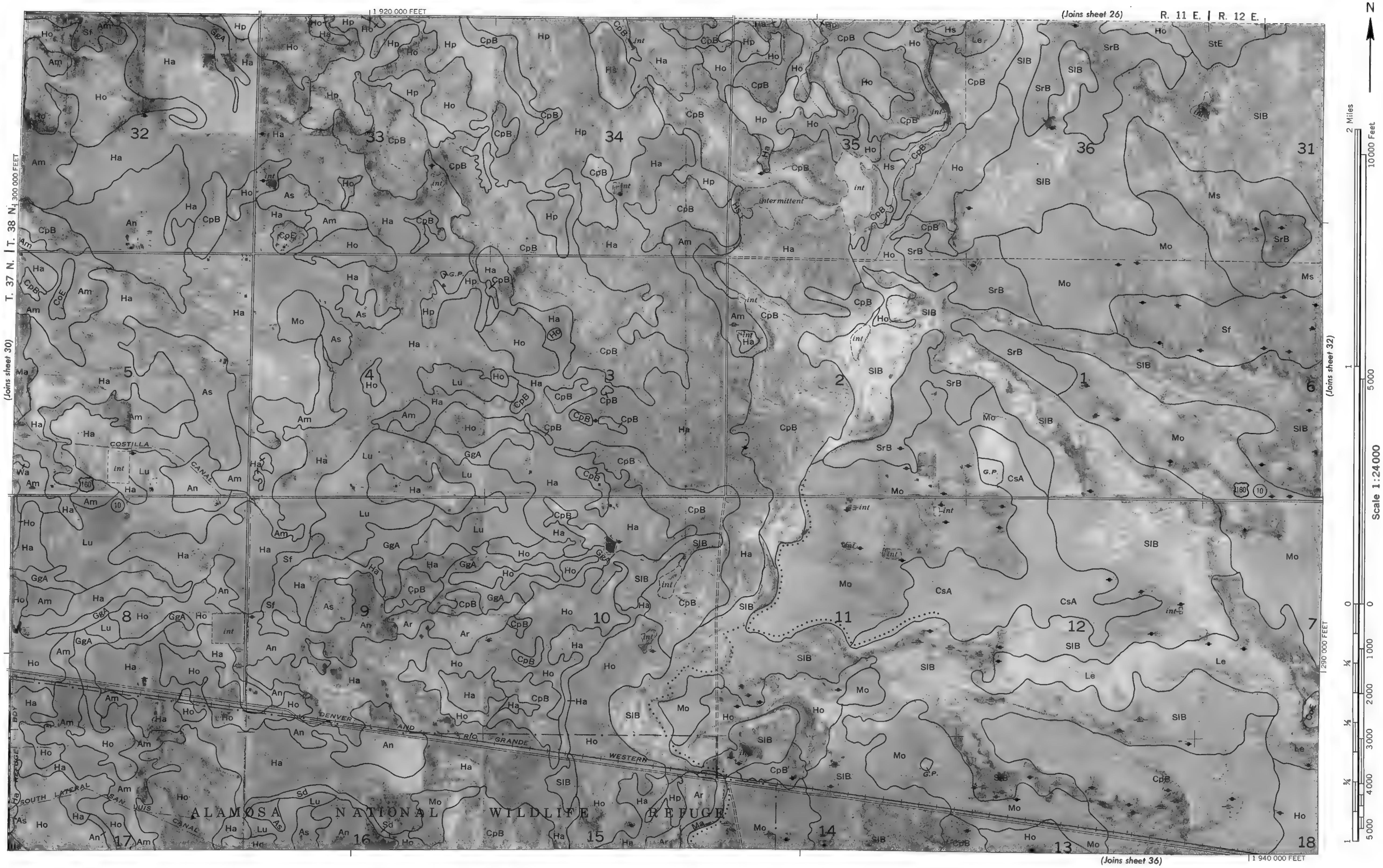
Land division corners are approximately positioned on this map.

Photobase from 1969 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the Colorado coordinate system, south zone.

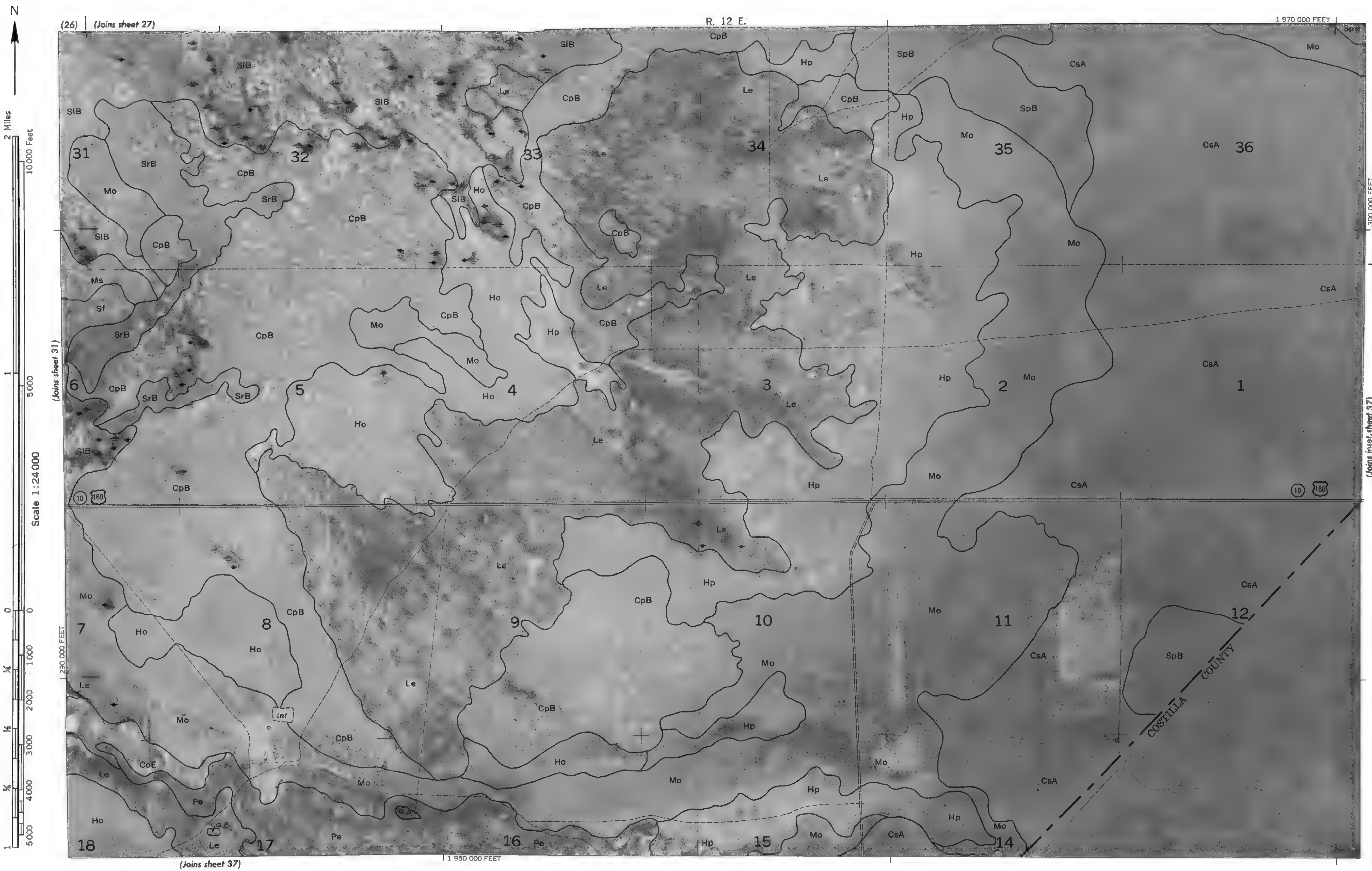
This map is one of a set compiled in 1971 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, in cooperation with the Colorado Agricultural Experiment Station.

This map is one of a set compiled in 1971 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, in cooperation with the Colorado Experiment Station.
Photobase from 1969 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the Colorado coordinate system, south zone.
Land division corners are approximately positioned on this map.

ALAMOSA AREA, COLORADO NO. 31



ALAMOSA AREA, COLORADO — SHEET NUMBER 32



ALAMOSA AREA, COLORADO NO. 32

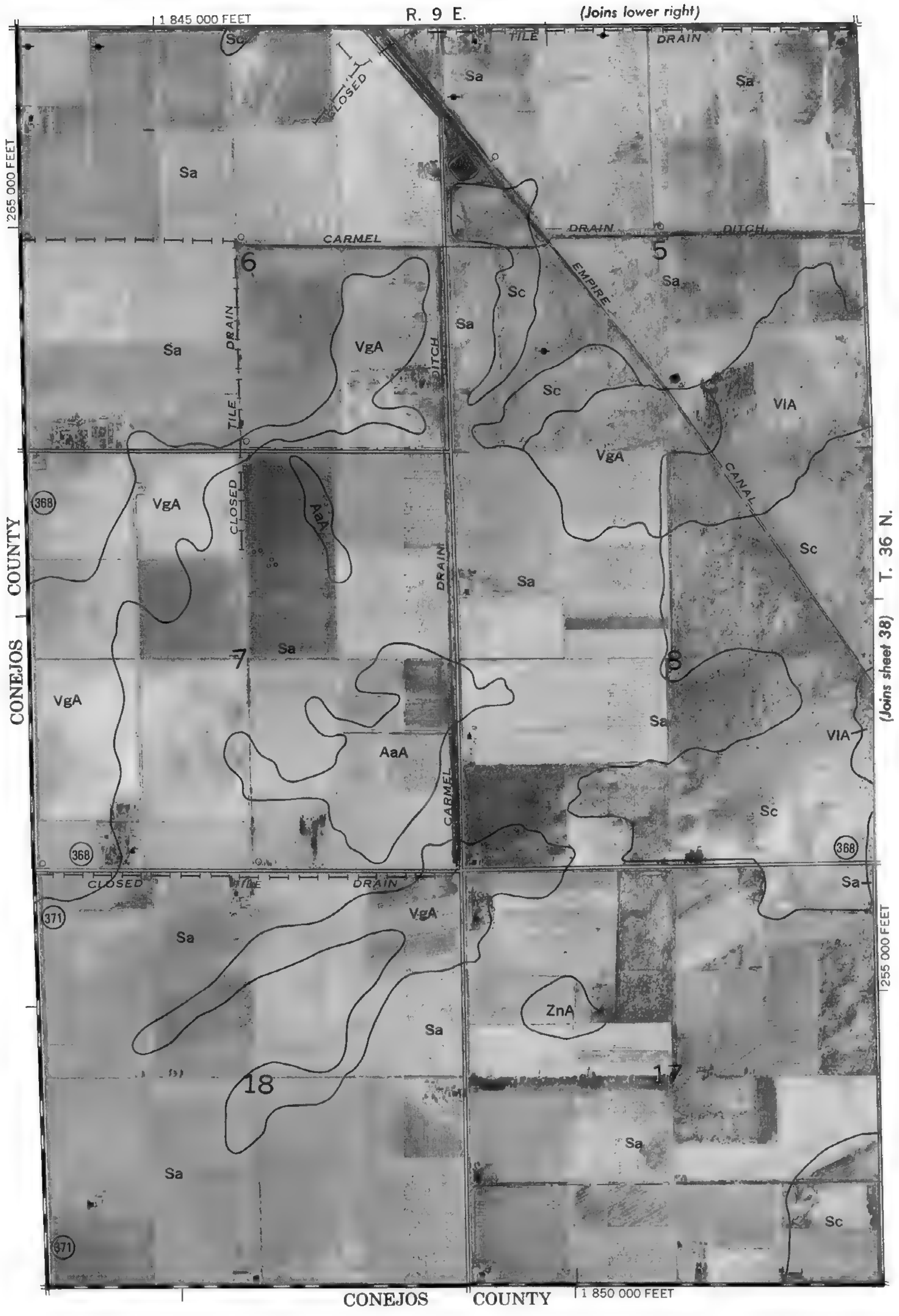
Land division corners are approximately positioned on this map.

Photobase from 1969 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the Colorado coordinate system, south zone.

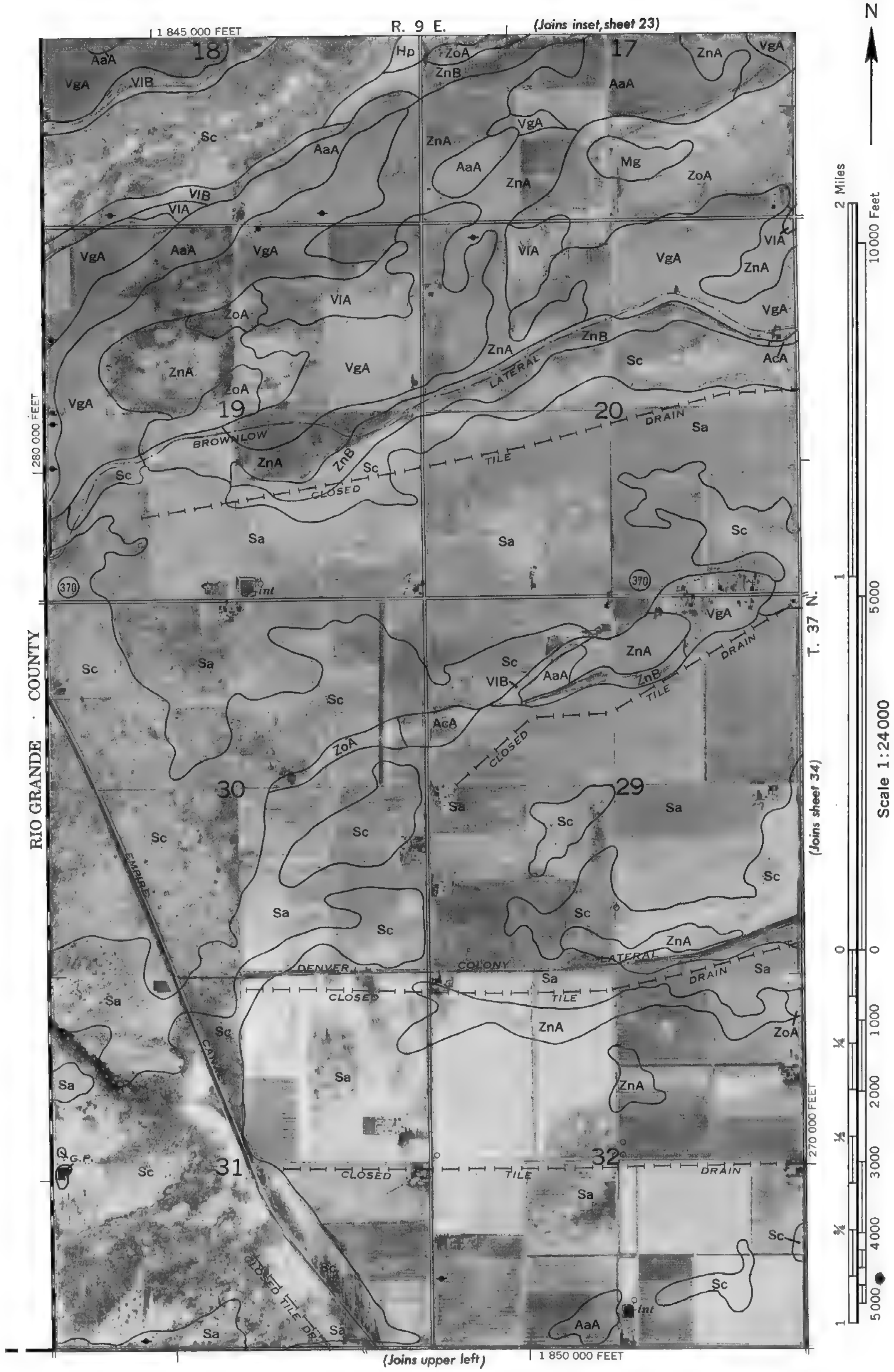
This map is one of a set compiled in 1971 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, in cooperation with the Colorado Experiment Station.

This map is one of a set compiled in 1971 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, in cooperation with the Colorado Experiment Station.
Photobase from 1969 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the Colorado coordinate system, south zone.
Land division corners are approximately positioned on this map.

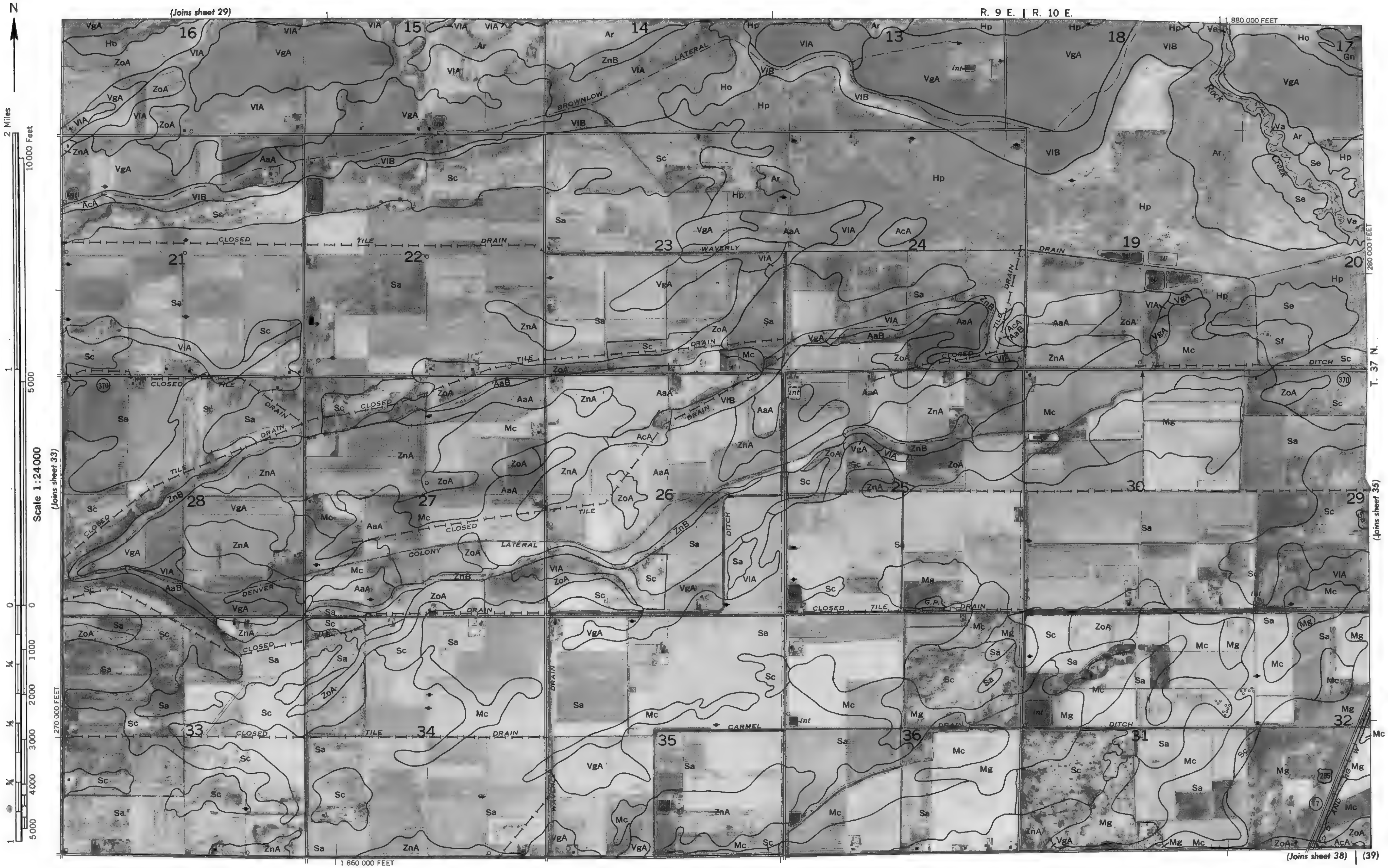
ALAMOSA AREA, COLORADO NO. 33



5000-Foot Grid Tick



5000 AND 10000 -FOOT GRID TICKS



ALAMOSA AREA, COLORADO NO. 34

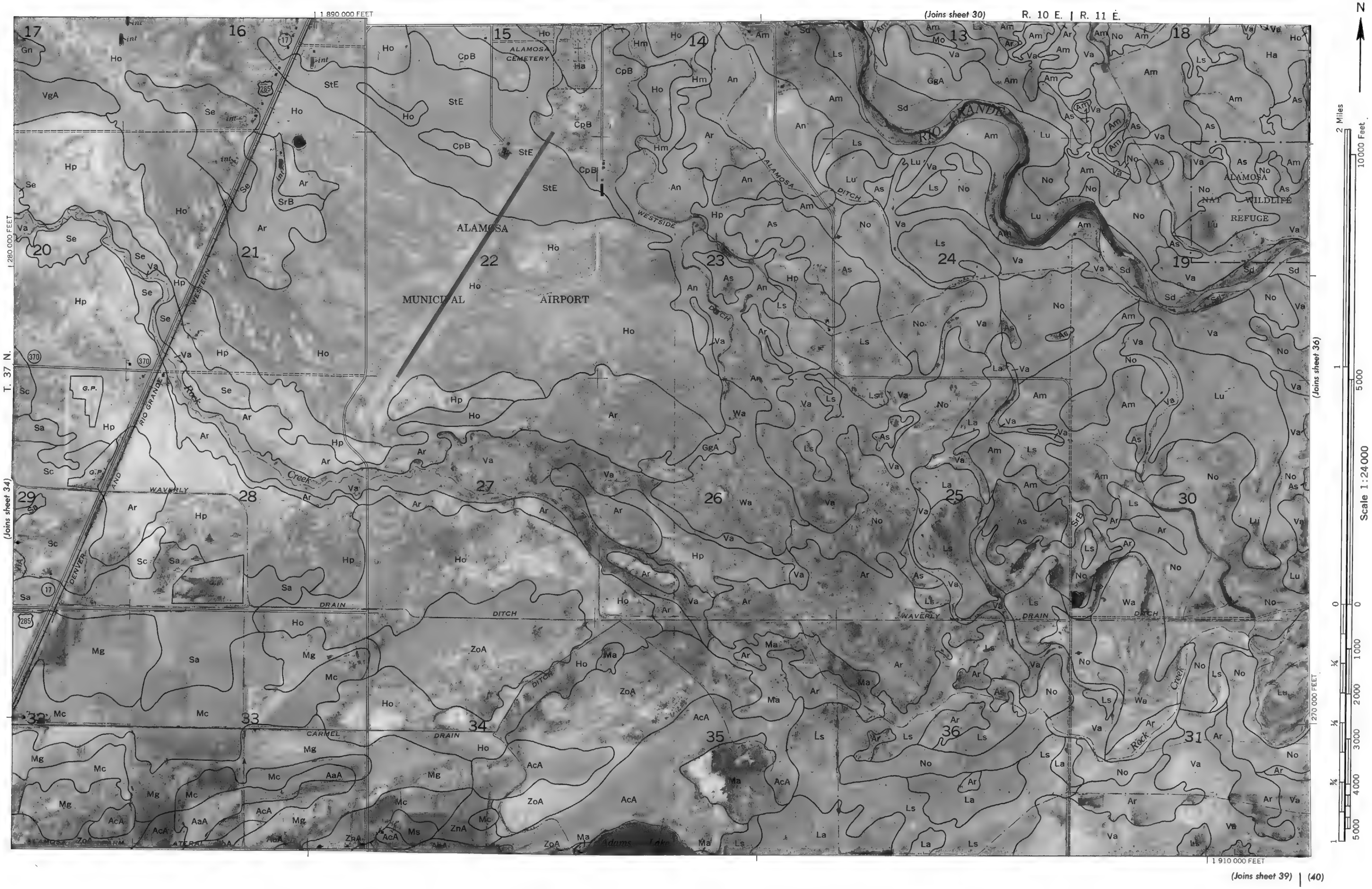
Land division corners are approximately positioned on this map.

Photobase from 1969 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the Colorado coordinate system, south zone.

This map is one of a set compiled in 1971 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, in cooperation with the Colorado Agricultural Experiment Station.

This map is one of a set compiled in 1971 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, in cooperation with the Colorado Experiment Station.
Photobase from 1969 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the Colorado coordinate system, south zone.
Land division corners are approximately positioned on this map.

ALAMOSA AREA, COLORADO NO. 35

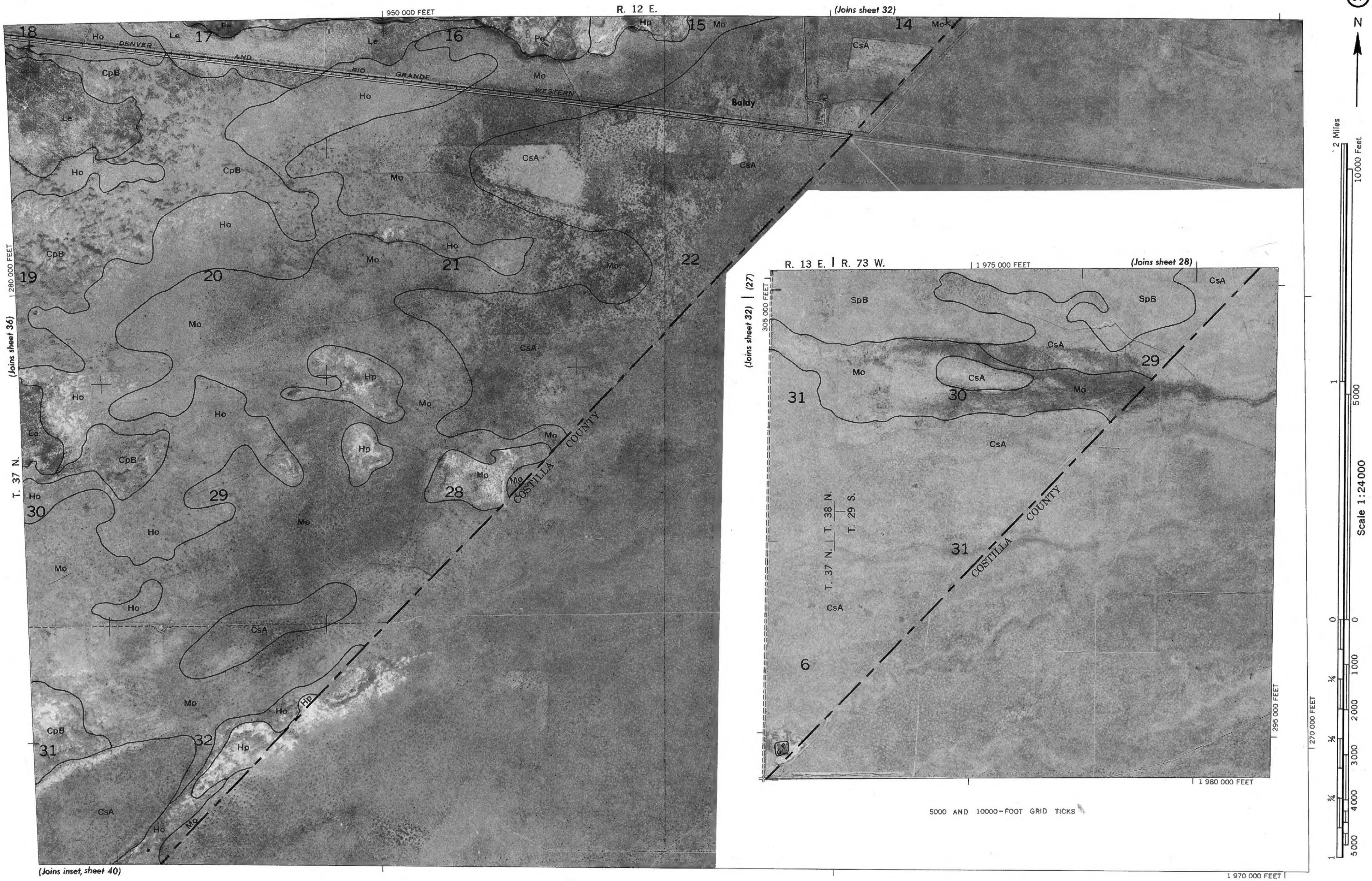


ALAMOSA AREA, COLORADO NO. 36

Land division corners are approximately positioned on this map.

Photobase from 1969 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the Colorado coordinate system, south zone.

This map is one of a set compiled in 1971 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, in cooperation with the Colorado Agricultural Experiment Station.



This map is one of a set compiled in 1971 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, in cooperation with the Colorado Experiment Station.
Photobase from 1969 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the Colorado coordinate system, south zone.
Land division corners are approximately positioned on this map.

ALAMOSA AREA, COLORADO NO. 37

ALAMOSA AREA, COLORADO — SHEET NUMBER 38

ALAMOSA AREA, COLORADO NO. 38

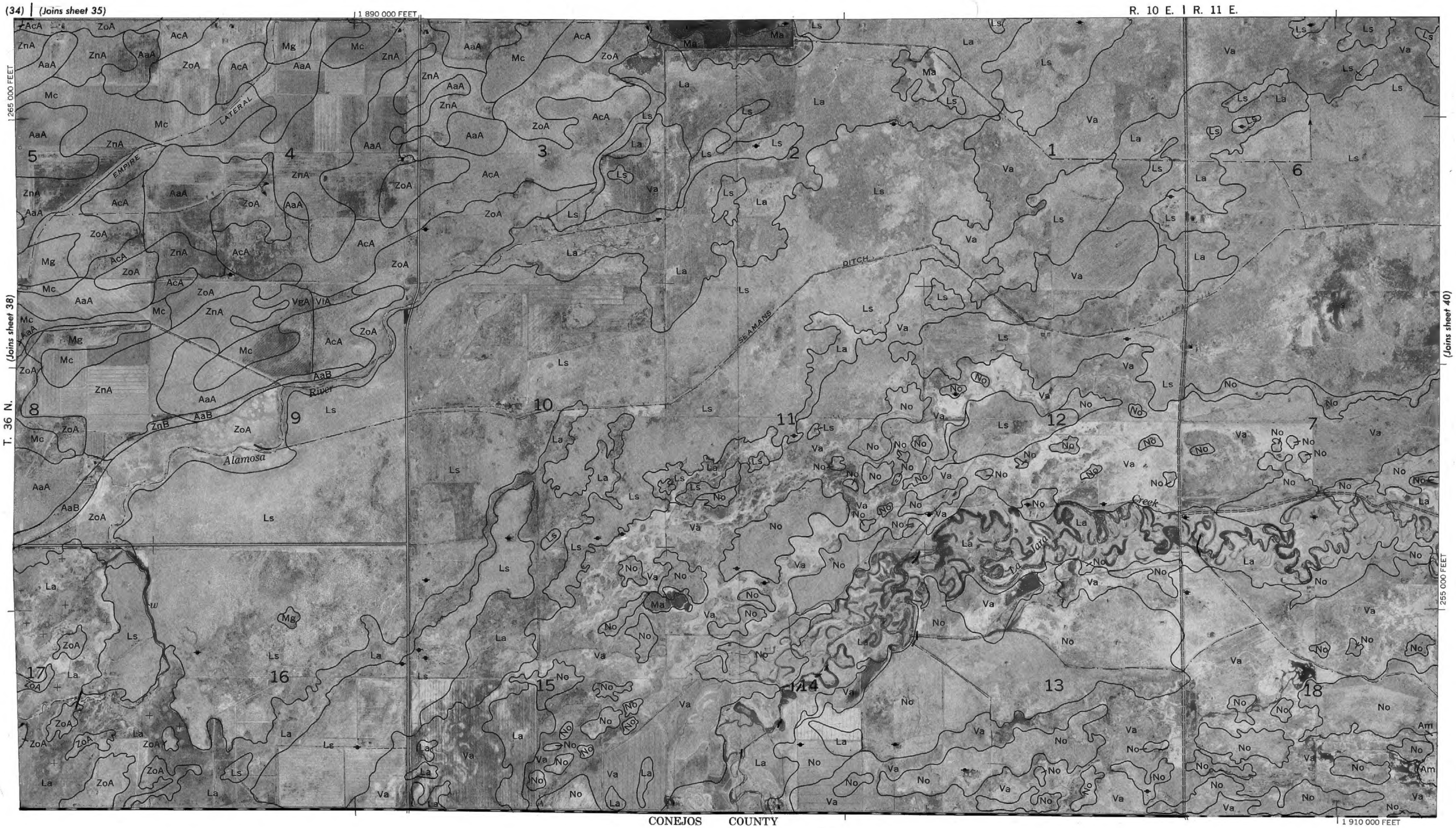
Land division corners are approximately positioned on this map.

Photobase from 1969 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the Colorado coordinate system, south zone.

This map is one of a set compiled in 1971 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, in cooperation with the Colorado Agricultural Experiment Station.

(39)

N



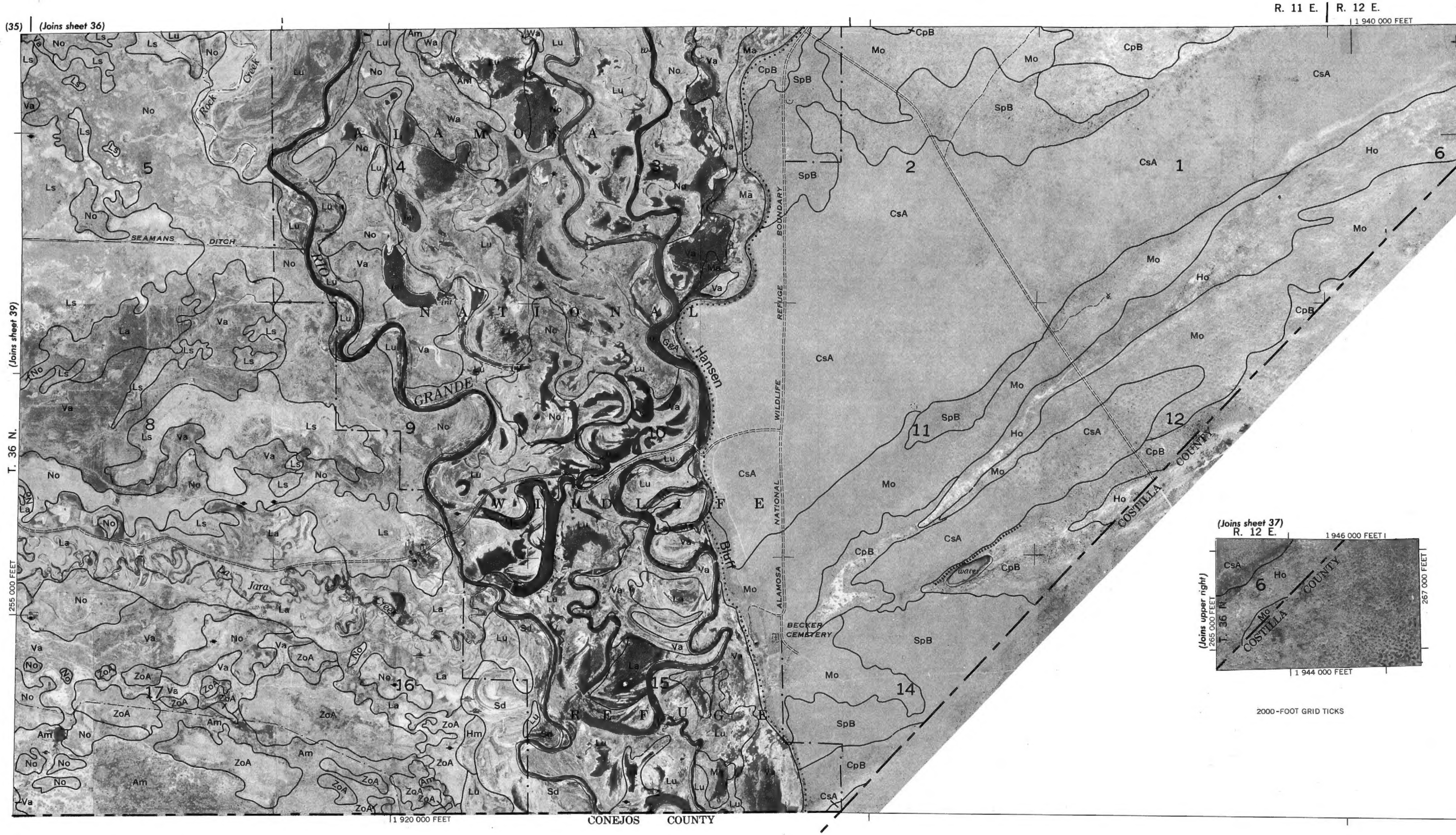
5000 AND 10 000-FOOT GRID TICKS

This map is one of a set compiled in 1971 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, in cooperation with the Colorado Experiment Station.
Photobase from 1969 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the Colorado coordinate system, south zone.
Land division corners are approximately positioned on this map.

ALAMOSA AREA, COLORADO NO. 39

Scale 1:24 000

2 Miles — 10 000 Feet



5000 AND 10000-FOOT GRID TICKS

Land division corners are approximately positioned on this map.

Photobase from 1969 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the Colorado coordinate system, south zone.

This map is one of a set compiled in 1971 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, in cooperation with the Colorado Experiment Station.

ALAMOSA AREA, COLORADO NO. 40